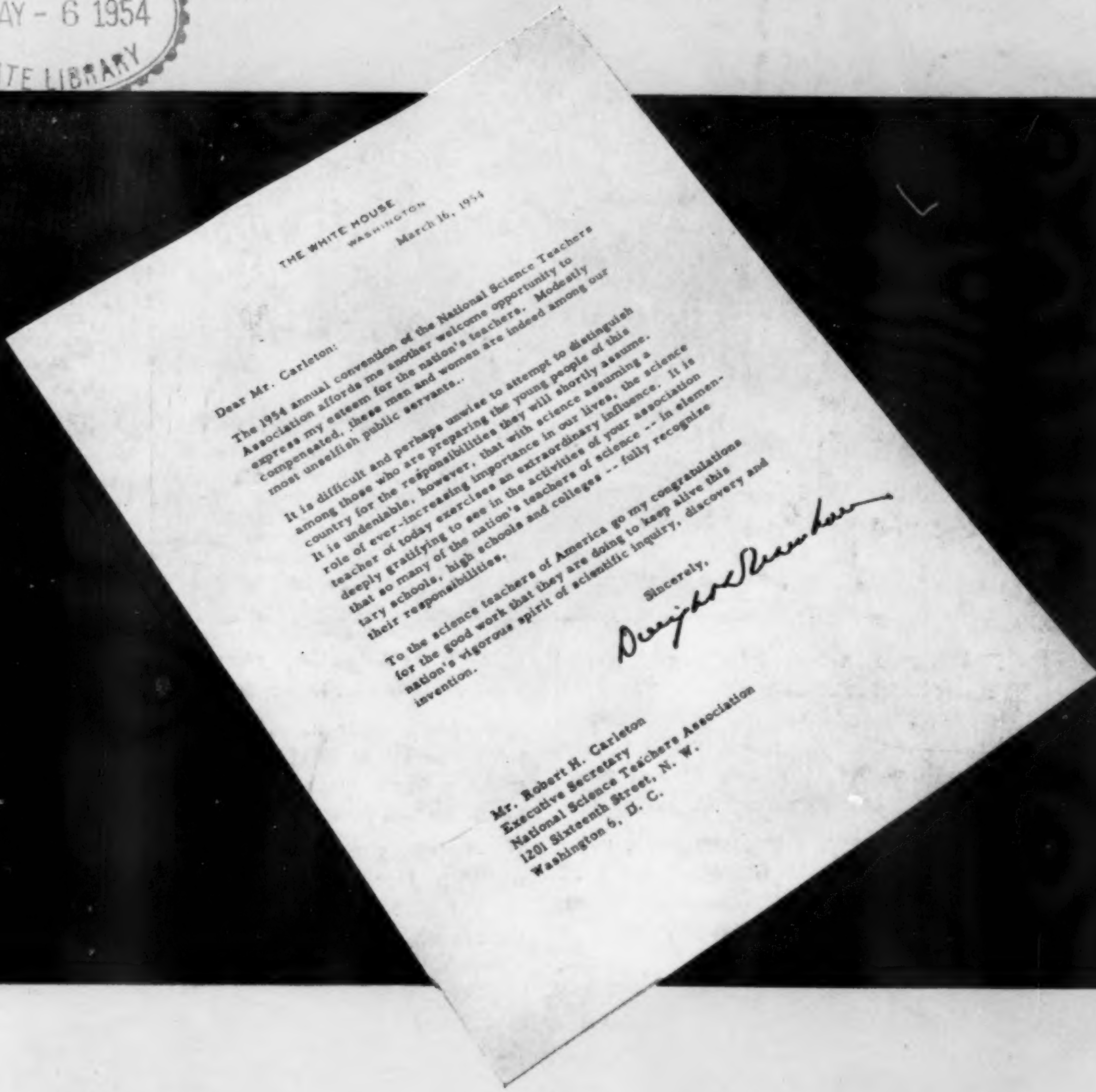
Vol. XXI, No. 3
APRIL 1954

THE SCIENCE TEACHER



THE WHITE HOUSE
WASHINGTON

March 16, 1954

Dear Mr. Carleton:

The 1954 annual convention of the National Science Teachers Association affords me another welcome opportunity to express my esteem for the nation's teachers. Modestly compensated, these men and women are indeed among our most unselfish public servants.

It is difficult and perhaps unwise to attempt to distinguish among those who are preparing the young people of this country for the responsibilities they will shortly assume. It is undeniable, however, that with science assuming a role of ever-increasing importance in our lives, the science teacher of today exercises an extraordinary influence. It is deeply gratifying to see in the activities of your association that so many of the nation's teachers of science -- in elementary schools, high schools and colleges -- fully recognize their responsibilities.

To the science teachers of America go my congratulations for the good work that they are doing to keep alive this nation's vigorous spirit of scientific inquiry, discovery and invention.

Sincerely,

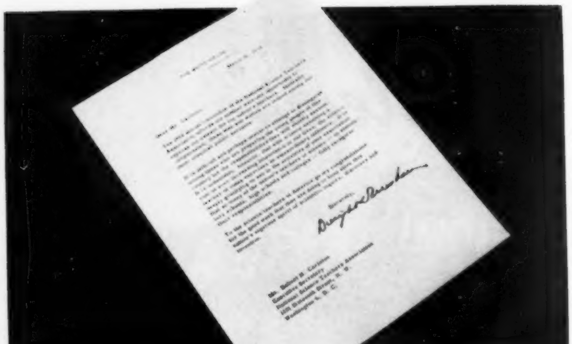
Dwight D. Eisenhower

Mr. Robert H. Carleton
Executive Secretary
National Science Teachers Association
1201 Sixteenth Street, N. W.
Washington 6, D. C.

- Is Modern Science Inductive?
- Laboratory Activity in Astronomy
- Cooperative Activities in Elementary Science
- Directory of Summer Workshops and Courses
- Why Study Engineering?

JOURNAL OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION

Please mention THE SCIENCE TEACHER when you write.



THIS MONTH'S COVER . . . rather speaks for itself! It is indeed heartening to receive such recognition from the President of the United States. With pardonable pride, we are happy that he decided to send his message to the nation's science teachers by way of NSTA on the occasion of the Second National Convention.

Readers' Column

Future algebra books need certain corrections. Most of these books intended for high school or elementary college courses have problems of the so-called "mixture" type. The assumption which underlies these problems is that the volumes of two (or more) different liquids combine to give a mixture whose volume is the sum of the volumes of the liquids. On a physical basis this is contrary to fact.

The usual liquids involved are alcohol and water, or various mixtures of the two. From actual observation, 250 ml. of water and 250 ml. of alcohol will mix to give about 485 ml. of mixture, varying somewhat with the temperature and denaturing agent if any. The shrinkage is due to intermolecular penetration phenomena. The same factor operates whenever the liquids mixed are not identical.

Practically any algebra book would serve for illustration. Consider the following, taken from *College Algebra* by Keller, Houghton Mifflin Co., 1946:

> "A garageman has twelve gallons of anti-freeze mixture which is 30% alcohol and 20 gallons of anti-freeze which is 72% alcohol. He wants to combine portions of these to make 10 gallons of anti-freeze mixture which is 55% alcohol. How many gallons of each should he use?"

The book gives an answer: "$4\frac{1}{2}$ gallons of the first and $5\frac{20}{21}$ gallons of the second mixture," and goes on to point out that, "We must, in general, temper our results to meet practical consideration. In ordinary work, we should probably use 4 gallons of the 30% mixture and 6 gallons of the 72% mixture, and the 10-gallons would be 55.2% alcohol."

But *this is hardly practical* since, in this case, *4 and 6 do not equal 10.*

The algebra teacher would object to the student adding 6 oranges and 4 apples and getting 10 oranges. The physics-chemistry teacher has a right to object to the algebra teacher adding s quarts of alcohol to t quarts of water and getting $(s + t)$ quarts of mixture. The requirement that only like can be added to like holds equally in each case.

There would seem to be no good reason why future algebra books should not state problems of this type so that they will not violate well known (to physical scientists) facts. The teachers of physical science should be aware of the false suppositions involved in such problems—as stated and solved in most algebra books—so that they may correct the false beliefs that have been placed in the minds of many students.

R. B. Leach
Tacoma, Washington

I want to assure you that the Association is, in my opinion, doing a wonderful service for the cause of science teaching. The magazine is unexcelled in its field, and the regional meetings, together with the national conferences with their inspirational deliberations combine as a new force in the improvement and unification of science instruction in the public schools of this country.

Jerome Isenbarger
Bradenton, Florida

Enclosed is my check for $40 which completes payment for my Life Membership. I have just taken an interior trip, walking over, under, around, and through logs, swamps, streams, and interlacing jungle. To the Liberian *all* snakes are poisonous (and eight varieties are) with no antidote in sight. All birds are for chop (food). There is no natural death. One dies from the influence of enemies and everyone has them. I saw a baby die of malnutrition. The mother's milk had dried up and the baby was trying to exist on cassava water. The mother wailed and shrieked; recalled that she had stepped on a ring made of grass (some one's medicine).

Farms are increasing through necessity as Liberia has never been able to feed itself. It seems so remarkable when it is so easy to grow food here and when I remember the Chinese who were able to get three crops a year from their land.

We are having a Teachers Vacation School now—a real struggle indeed to prepare them for the changes roads into the interior are bringing. Hope to attend another NSTA conference in December '54.

Catherine C. Barnaby
Robertsport, Cape Mount
Liberia, West Africa

THE SCIENCE TEACHER

The Journal of the National Science Teachers Association, published by the Association, 1201 Sixteenth Street, N. W., Washington 6, D. C. Membership dues, including publications and services, $4 regular; $6 sustaining; $2 student (of each, $1.50 is for Journal subscription). Single copies, 50¢. Published in February, March, April, September, October, and November. Editorial and Executive Offices, 1201 Sixteenth Street, N. W., Washington 6, D. C. Copyright, 1954, by the National Science Teachers Association. Entered as second-class matter at the Post Office at Washington, D. C., under the Act of March 3, 1879. Acceptance for mailing at Special rate of postage provided for in the Act of February 28, 1925, embodied in paragraph (d), Section 34.40 P. L. & R. of 1948.

MEMBERSHIP

The membership year coincides with the calendar year. New entries during the fall months extend through the following calendar year. Library and elementary school subscriptions coincide with the school year or run for one year from date of entry.

Active Membership	$4.00
Sustaining Membership	$6.00
Student Membership	$2.00
Library Subscription	$5.00
Elementary School Subscription*	$5.00
Life Membership	$100.00

(payable in annual installments of $10.00)

*** Includes the *Elementary School Science Bulletin* in quantity lots.**

This Issue . . .

of *The Science Teacher* concludes our spring series. The next issue will appear in September. Meanwhile, all NSTA members and subscribers are reminded: (1) be sure to renew for 1954 and 1955 so as not to miss any issues of *TST* or other services; (2) plan to become a *TST* author yourself; we especially need more "Classroom Ideas" articles. A Pleasant and recreational summer to all! *The Editor*.

THE SCIENCE TEACHER

Vol. XXI, No. 3 **April, 1954**

Articles published in THE SCIENCE TEACHER are the expressions of the writers. They are not a statement of policy of the Association or the Magazine Advisory Board.

The National Science Teachers Association is a department of the National Education Association and an affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction and later expanded as the American Council of Science Teachers, it merged with the American Science Teachers Association and reorganized in 1944 to form the present Association.

IS MODERN SCIENCE *Inductive?*

By ERNEST E. BAYLES

Professor of Education, The University of Kansas, Lawrence

IN a late 1950 issue of *The Science Teacher* an article appeared, written by a person who was characterized as "one of the 'deans' of science education in America," in which the case was pleaded for inductive teaching. Following are excerpts from the article:

> In their required courses in psychology prospective teachers of science are taught the nature and importance of both the inductive and the deductive methods of instruction. Yet, later, when these young teachers begin their careers, they follow the practices of an overwhelming majority of high school teachers . . . in practically, if not completely omitting the inductive method.
>
> In inductive teaching the pupil starts with some problem, the answer to which he does not already know. He then assembles, by observation or experiment, or both, evidence from which he can arrive at a tentative answer to the problem.

Then follows a quotation from the Forty-sixth Yearbook of the N.S.S.E.,

> By inductive teaching is meant progressing from the particular to the general, or more specifically, from facts to concepts and principles.

Further quotations from the article,

> The inductive method is the one by which scientific knowledge has grown from its earliest beginnings;
>
> Where the inductive method has inherited its logical place, as it has in a small but increasing number of high schools, these (deductive) procedures are reversed. The laboratory work comes first and the study assignments follow it.

This is not an isolated case. In fact, it is quite common. We find eminent writers or speakers on American educational theory frequently referring to or thinking of the method of modern scientific investigation as that of induction. In another 1950 publication, a book on educational philosophy by a well-known author, the following expressions are typical—"experimental induction," "we study inductively," "scientific (in the modern sense) and inductive," "an inductive study."

Again, during February, 1953, at a nation-wide educational meeting in Chicago, a professor of physics and of the philosophy of science from a leading university, after first commenting that science teaching at the general-college level should be deductive, characterized scientific investigation as inductively arriving at principles and then deductively putting them to work. A late-1952 title in *The Science Teacher* was, "An Inductive Approach to General Science through Photography," and, in late 1953, "Try the Inductive Approach."

In sharp contrast, in a book published in 1950, Albert Einstein wrote as follows:[1]

> There is no inductive method which could lead to the fundamental concepts of physics. Failure to understand this fact constituted the basic philosophical error of so many investigators of the nineteenth century. (P. 78)
>
> Physics constitutes a logical system of thought which is in a state of evolution, and whose basis

[1] Einstein, Albert. *Out of My Later Years.* New York: Philosophical Library, 1950.

> cannot be obtained through distillation by any inductive method from the experiences lived through, but which can only be attained by free invention. (P. 96)

The foregoing quotations are presented for the purpose of emphasizing a point in teaching theory which is a present subject of widespread confusion. The authorities first quoted are not alone in their contentions. It may have been thought, at least hoped, that the assertions in methods books of a half-century ago, on inductive and deductive teaching, would by now have been corrected. But such seems not to be the case.

In those earlier methods books, usually in a chapter of its own, supposedly deductive teaching was described and assigned a place. Another chapter would then deal with inductive teaching, with instructions as to when it, in turn, should be used. The thought was that pre-scientific thinking was deductive and that it should be used only for those aspects of a course in which a truth has presumably been already established. The teaching procedure then would be to start with the presumed truth (a general idea) and proceed by logical deduction to unravel its meanings for particular or concrete cases.

On the other hand, an inductive lesson would be one in which observations of concrete cases would first be made, after which by induction a generalization would be reached. This inductive method, as the two first-quoted authors indicate, was taken to be the scientific way to obtain truth and the major way in which science classes should be taught. It was a case of "gather the facts and let the facts speak for themselves."

That Einstein has spoken so emphatically against induction as the method of modern scientific investigation will come perhaps as a distinct shock to many science teachers. What can he possibly have meant? The meaning will be clear to those who have carefully thought through the implications of "the complete act of thought" as described and explained in 1910 by John Dewey and as supported and elaborated by certain of Dewey's later writings and by writers such as P. W. Bridgeman and Boyd H. Bode.

According to Webster-Merriam Unabridged Dictionary, induction is an "Act or process of reasoning from a part to a whole, from particulars to generals, or from the individual to the universal." And, according to Runes' *Dictionary of Philosophy,*

> "Perfect" induction is assertion concerning all the entities of a collection on the basis of examination of each and every one of them. The conclusion sums up but does not go beyond the facts observed.

Newton, near the end of the third book of *Principia Mathematica* in which he is speaking slightly out of the present context but not enough to make his comments inapplicable here, wrote

> . . . and I frame no hypotheses; for whatever is not deduced from the phenomena is to be called an hypothesis; and hypotheses . . . have no place in experimental philosophy. In this philosophy particular propositions are inferred from the phenomena, and afterwards rendered general by induction.

Induction is, thus, taken in strict theory to be a process of gathering the facts and letting the facts speak. Be "thoroughly objective"; approach the facts with an "open mind"; read nothing of personal opinion or bias into them. This, in strictly theoretical expression, represents the Newtonian "method of science"—philosophic Realism—and is what Einstein had in mind when he made the previously quoted statements in denial of the efficacy of induction. Eby and Arrowood,[1] in describing the inductive method (or "New Organon") of Francis Bacon, point out that

> Experimentation, as a process, is not different from observation, but involves merely the expert control of conditions, so to facilitate or simplify observation.

We add this point in order to make clear that, although experiments were performed by those who considered the scientific method as strictly inductive, their interpretation of the nature of experimentation was quite different from the interpretation placed upon it by theorists such as Einstein and Dewey.

In contrast, the scientific-reflective process as envisioned as well as practiced today may be described as follows. First, a problem appears. Available facts or data, some of which perhaps are only newly discovered, appear not to be interpretable on the basis of previous theory. For example, during several years prior to the "discovery" of Pluto, the observed orbit of Uranus appeared to be slightly divergent from what it should have been if only the then-recognized planets existed. Fact and theory were a bit at odds with one another, and astronomers wondered why.

Second, hypotheses are formulated. In order to account for the evident discrepancies in the orbit of Uranus, the existence of an additional planet was assumed or posited. To this point, the process appears to be distinctly inductive. But the conclusion (a generalization) is still a considerable way off.

[1] Eby and Arrowood. *Development of Modern Education*. New York: Prentice-Hall, Inc., 1934. P. 239.

Third, implications (or logical consequences) of the new hypothesis are deduced. In our example, those of the old had long since been thoroughly worked out and found to be out of keeping with current observations, thereby creating the problem. Assuming a then-unknown planet, by logical deduction—in this case mathematical—determination was made of size, location, orbit, and velocity of the assumed additional planet. At this point the "deduction" was distinctly inductive in direction; it proceeded toward precise formulation of the generalization—the nature of the assumed planet.

However, it now took a deductive turn; but in two directions. The first was mere reversal of the just-noted *inductive* deduction. On the basis of precise assumptions regarding the new planet, could the facts already known be precisely deduced? To this point, there was little of what might have been termed experimentation.

Then deductions were turned toward the future; toward predictions of possible facts which were at that time unknown. Where, when, and under what conditions might the possible new planet be seen? Training the telescope upon the right places, at the right times, fulfilling other requisite conditions, and making the proper observations had all of the characteristics of modern scientific experimentation. It was not a mere case of gathering what could be gathered in the manner of a dragnet. The "blinker" technique, for example, was a manufactured one, designed to produce a set of facts highly peculiar to this particular investigation and unobtainable except by way of carefully executed design.

The fourth and final step in the scientific-reflective process is arrival at a conclusion. In light of the information which has been gathered, what interpretation or generalization is indicated?

There are many who fail to realize that scientists hold themselves accountable for living up to a certain set of rules or criteria in arriving at a conclusion. Scientists do not think of only one *right* conclusion as possible and of arrival at any other as a result either of gross incompetence or of vicious intent. Specifically, scientists insist that all possible facts shall be gathered and that, in reaching a conclusion, all such facts shall be taken into account. This we may call the principle of adequacy. Furthermore, the *interpretation* of the facts which is taken to be satisfactory and thus to conclude the study—hence the *conclusion*—is the one which causes all of the collected facts to fall together in a harmonious pattern, one in which the logic is clear so as to make deductions readily possible. This can be called the principle of *harmony*. Thus, the rule or criterion which scientists employ when they sit in judgment on hypotheses is that of *adequacy and harmony in light of available or obtainable data.*

That this criterion does not represent what all persons take to be a universal good should be evident to anyone who will take a moment to consider how human minds work. Are there not those among us who insist that we *must* believe in God, even though they themselves admit that there is no scientific evidence to support such a belief? Whether we should entertain such a belief, or should not, is not the question here. The point is that the scientific rules or criteria for determining what conclusions are good and what are not good do not represent rules or criteria which enjoy universal acceptance. In this sense they cannot be taken as representing a Universal Good, and it would perhaps be quite unwise or unjust to dub a person either incompetent or vicious who does not take them to be so. All we should say, seemingly, is that there are myriads of occasions upon which human minds arrive at conclusions on bases other than scientific. Whether they should do so is quite another matter.

Summarizing the steps of the scientific-reflective method as we have described it, (1) a problem arises because available data seem to be out of harmony with one another in light of current interpretations or generalizations; (2) alternative interpretations are sought, new ones are invented if necessary, and all are taken into consideration (typically called hypotheses); (3) on the basis of each hypothesis, which serves as a generalization, concrete facts are deduced, some of which may already be known whereas others require experimental derivation because they are not already known; (4) if one of the hypotheses is found to harmonize all known facts and to predict with accuracy unknown facts—the criteria of *adequacy* and *harmony* in the interpretation of available or obtainable data, the conclusion is that it has been found to be an acceptable hypothesis. Contrariwise with reference to step (4), if no considered hypotheses are found to satisfy the criterion, the conclusion is that the problem is not yet solved. This, it seems reasonable to say, is the method of modern scientific investigation.

The story of Einstein's arrival at his interpretation of the way the world runs is well told by Max Wertheimer in the seventh chapter of his posthumously published book, *Productive Thinking*. That account well illustrates the process as above described. And it well shows why Einstein would say, as noted earlier, that "physics constitutes a logical system of thought . . . . whose basis . . . .

can only be attained by free invention." Hypotheses do indeed represent "free invention," and it was for this very reason that Newton declared, "I make no hypotheses."

The fact that science-education theory has long been satisfied to characterize the scientific method as an inductive process, not a deductive one, is responsible for much of the puttering, time-consuming, uneducative busy work which is carried on in secondary-school and college or university science laboratories. In his little book, *On Understanding Science,* James Bryant Conant remarks that, "the amassing of data does not constitute advance in science." (P. 103). This remark we would commend for careful consideration by all science teachers, secondary or college, as well as Conant's entire chapter four in which it appears. Science teachers would also do well to consider with care the following statement, made in a book review, by J. L. Walsh, Perkins Professor of Mathematics in Harvard University,[1]

> The investigator should not fear the charge of "arguing by analogy." Perhaps the truest of the world's wisdom is embodied in parables—indeed, perhaps all wisdom consists in parables, including analogies and abstractions.

To expect that high-school and college students will be greatly educated by much of what they are required to do in their regular laboratory work seems unrealistic, to say the least. What, in terms of genuine scientific investigation, can be genuinely achieved even in college classroom laboratories is not a great deal. If we, who are or have been science teachers, would take seriously a certain widespread attitude on the part of students, some rather fundamental changes in the conduct of classroom-laboratory work might soon be in the making. That attitude is that the educational value which students are expected to extract from laboratory work is a bit hard to define; that the instructors themselves are far from clear on what it should be; and that the work, therefore, is to be done and the reports written with the least possible expenditure of effort and time.

If this attitude were entertained only by less capable students, those who generally are unappreciative of the value of intellectual effort, it might be brushed aside as unworthy of professorial consideration. But, although most science instructors may be able to adduce notable exceptions, it is an attitude held by hosts of highly capable and excellent students as well as by others.

A direct result of such an attitude is the widespread, long-time practice, whenever students can possibly do so, of employing extra-laboratory sources for obtaining the information necessary to write reports—textbooks, other students' reports, etc. Much of the time, science teachers choose to ignore this situation. And much of the time when the situation is recognized as a problem, it is a presumed deterioration of the moral fiber of present-day students which is deplored.

It is the sense of this paper that *science teachers would do well to reconsider their basic conceptions of classroom science-laboratory work and see whether some fault might also reside there.*

Has it indeed come to pass that students are in large part viciously lazy? Are they fundamentally opposed to expenditure of intellectual effort? Or might it be that students are more critical than "in the old days" and, when they find certain supposedly educational requirements to be essentially non-educative, they circumvent them if possible?

Observation of natural facts and events is indeed an aspect, and an essential one, of modern scientific-reflective investigation. But it is far from all. Yet, to consider scientific investigation as essentially inductive—a case of gathering the facts so that the facts may speak—is to make observation of natural facts and events essentially *the* method of scientific investigation. In such case, following instructions in laboratory manuals so that the particular facts envisioned by the author may be observed by the students is, logically, *the* method of science instruction. Generalizations will then follow as a matter of course.

But, when a genuine problem—one which for students is a really I-don't-know situation—is a prerequisite, when *invention* of hypotheses and pursuance of thought for what can be logically deduced from these hypotheses are recognized as essential precursors to experimentation, then scientific investigation is much more than simple induction or the gathering of facts by observational methods. Classroom-laboratory work, when conceived in this manner, will be taken as an integral part of the entirety of classroom study regarding a given problem. And, when an experiment necessary to shed light on the over-all study is impossible of performance in a classroom, it will be thoroughly justifiable to think of laboratory procedure as requiring careful study of a *report* of such an experiment, one performed by those who are competent and have the needed facilities.

For example, long-time and complicated nutritional experiments on growing plants and animals

(Please continue on page 145)

[1] *Scientific American:* August, 1949; page 56.

FIRST WEEK OF SCHOOL IN SCIENCE

A Symposium of Ideas and Experiences

Each fall with the beginning of a new school year, millions of eager youngsters thread their way into the science classrooms of our junior and senior high schools. For many of these pupils, this will be their first experience with a course in science, or with a *laboratory* course in science. How can we meet them more than half way and help assure that they—and we, their teachers—get off to the best start possible? After a week of "science," will the youngsters view it with the attitude of Dame Carruthers or of Sergeant Meryll as, in G and S's *Yeomen of the Guard,* they contemplate approaching marriage?

> **"Joyful, joyful," sings the Dame;**
> **"Ghastly, ghastly," echoes the Sergeant.**

The eighteen participants in this symposium herewith share their effective approaches to that important first week of school in science classes. We hope this will prove to be a helpful exchange of ideas. *Editor.*

Our first contributor speaks from 25 years of experience. He is CLIFFORD R. NELSON, teacher of general science in the Weeks Junior High School, Newton, Massachusetts.

The doctors, lawyers and Indian Chiefs of tomorrow troop into the science room with a vigor and vitality that American youth is famous for. Can I, their science teacher, begin to match it? That is the jack-pot question. To match it properly and to the extent that one is able requires the teacher to have previously determined goals and objectives. These goals and objectives will, of course, reflect the philosophy of the teacher.

Among the goals which have been set up for myself and the boys and girls whom I am to meet are these:

1. To meet the routine requirements of opening school.
2. To give the boys and girls an opportunity to meet and begin to know me, their teacher.
3. To become acquainted with these boys and girls.
4. To offer the children an opportunity to develop the feeling that they are an important part of the group and have a significant role to play.
5. To review the science background of each boy and girl.
6. To determine their present science interests and needs.
7. To "set our teeth" into a unit of work which they feel should be explored.

It does not seem necessary to elaborate on all of the above objectives; any teacher's experience will reflect one or more of them. However, comments on a few may help to establish a point of view.

Item two is a significant one to the writer. No attempt is made to establish oneself as an ogre who will make life miserable for he who transgresses; nor is one over-solicitous to convey the feeling that here is a saintly person who never considers a child to be in error.

Items five and six are achieved through the development of four. The method I have used is to ask the simple question, "What do you expect of ninth-grade science?" The first one to make a suggestion, which is usually a topic for study, is elected to go to the board and write her suggestion. As long as she is already at the board it is just natural for her to act as the recorder or secretary to write down the suggestions which will follow. We have a pupil secretary why not a pupil discussion leader? It is no trouble to get one to volunteer and the group is off under its own steam. At this point the teacher recedes into the background and becomes as one of the class. Things are said which reflect the pupils' backgrounds and interests. All of these are of value to the teacher who feels that such observations are necessary if he is to be of the greatest service to the children.

When item seven has been attained the work of the year has begun. This is achieved when the above discussion has been concluded and is natural in the sequence. The choice of unit follows another simple question such as, "Which of the listed topics seems to be the one you would most like to do?" Each person who wishes to speak for a topic is given the opportunity. After all have given their selection and reasons, an elimination vote is taken. The "losers" are told that we will reconsider their selection after we have finished with the topic selected by the majority.

Boys and girls who become involved in the planning and implementation of the work of the classroom feel that they have a stake in the whole enterprise and thus become more willing to insure the success of the class venture. If this feeling can be sincerely developed during the first week of school, the stage is set for a productive year of education.

Atlanta, Georgia, has considerable of a reputation for good science instruction in the public schools. Here is a sample of how one Atlanta teacher helps add to this reputation. She is KATHERINE HERTZKA, teacher of biology in Hoke Smith High School.

How not to disappoint the eager expectancy of some pupils; how to allay the fear that biology is a course of hard and distasteful work and of "cutting things up" in others; and how to overcome the vacation-inspired apathy of still others is challenge to the biology teacher as she meets her new classes each fall. How to replace disinterest with more than tolerance is especially important when general biology is required or elected merely to complete science requirements.

While the details vary each year, my general plan for getting off to a good start is to use the familiar and/or the excitingly unfamiliar as a "curtain raiser" for the kind of year I am hoping for—a year of growth, development, pleasure in learning, and stimulation to a continuation of learning by problem-solving for each young person in my room. Some devices I have used have included special bulletin boards, exhibits, experiments, reading something timely or exciting to the class, an occasional film, and an around-the-block field trip.

Last fall, for instance, the classes were greeted by bulletin boards flaunting, in red letters, "Biology—The Science of Life," accompanied by pictures of boys and dogs, frogs, fruits, flowers, and a praying mantis. In other years, bulletin boards have been designed with exotic plants and animals as a theme, or with biology in the news. Once a series of Ed Dodd's conservation comic strips made up the bulletin boards. Sometimes a board reads, "Where do you fit into this picture?" and has pictures of opportunities in science as well as announcements of science fairs and student contests for its message.

To read a story to a new class is an interest-arousing device which can fit into the usually shortened period and normal confusion of a first day. The story I chose last September was the account of a trip to the moon as told in Eisman and Tanzer's *Biology and Human Progress*. All space-minded, the class was caught up in a discussion of the reasons why life would not be possible on other bodies of the solar system.

The next day began with a prominent display of pictures of the conquest of Mt. Everest. There was time that day to listen to a few favorite space ideas as well as to explore the possibility that life could not exist comfortably everywhere on the earth. From the previous day's account, from the present day's discussion, and from an account which I read to the class of a jet flier's outfit and equipment, the class arrived at the idea that certain conditions were necessary for life and made a concise list of life needs.

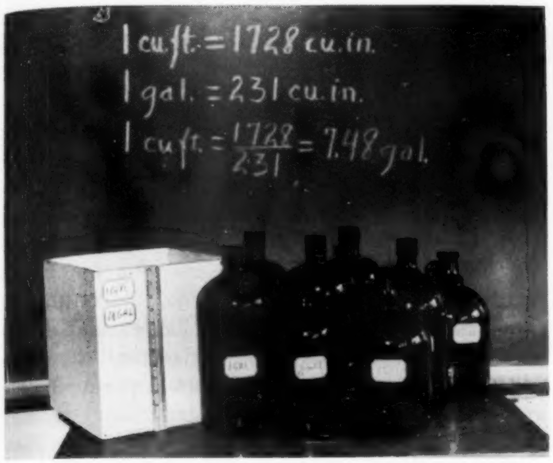
Just as soon as the class had decided that living things need air, they came in to see me sealing a snail and some Elodea into a test tube of water—blue water at that. They protested that the snail would die, asked how long it could live sealed up like that, why was the water blue, and what was the plant. To the first question I answered that they could wait and see for themselves, and suggested simple procedures for making observations and keeping records. I told them I had put bromthymol blue into the water and offered them means and opportunity of testing this chemical to learn about it. I told them the name of the plant. Then I asked them why they said the snail was alive. When one of them said it was moving, I rolled a small object across the desk and said, "So is this." The rest of the week was spent in determining how we might distinguish between living and non-living things.

When the class begins to bring in pets, insects, specimens of plants and animals, and jars of stagnant water, then they are ready for their books and instructions on the use of some of the tools of biology. The second week, and the weeks after that, take care of themselves.

Turning to high school physics, here is how MAHLON BUELL of Ann Arbor, Michigan, High School, gets started. He believes in emphasizing right from the beginning that physics is quantitative; but he starts with the familiar to help make new ideas of measurement take on real meaning.

"How much?" is one of the questions which the science of physics attempts to answer. Recognizing that this is true, the authors of practically all of our textbooks introduce measurements in the first or second chapters of their books.

Feet, pounds, and seconds, together with units that are closely related to them such as cubic feet,



Can you believe your eyes? How many gallons of water can be poured into a box which holds one cubic foot? Look at the photograph and try to estimate. Then figure it out. Students usually guess too low and readily recognize the need for exact measurements rather than guesses.

foot-pounds, and feet per second, are units with which the student has grown up. He has absorbed them along with his cereal and vitamins and they give him no particular trouble. But it is a little different with metric units such as centimeters, liters, and kilograms. These may be new and strange to him and he may need a little time in which to grow accustomed to their use. If he can associate them with his daily environment he will come to appreciate their importance more easily.

To impress upon my students the fact that metric measurements are often used to indicate the dimensions, weight, or volume of things commonly found in their homes, I place on display a collection of cartons, cans, bottles, and wrappers from the kitchen cupboard shelf or from the nearby super market. On the labels of all of these containers will be found references to the metric system.

The labels indicate that Scott cleansing tissue measures 22.8 by 24.7 cm., a box of Post Toasties weighs 8 oz. or 227 g., one ounce of Wheaties contains .15 mg. of thiamine and 1.275 mg. of iron, there are 88 cc. in a bottle of ink, a can of Dektol developing powder will make 3.78 liters of solution, and motion picture film is 8 or 16 mm. wide. The students pass these containers around and see for themselves, perhaps for the first time, that metric units really are used in trade.

Such a display never fails to bring expressions of surprise from my students and I believe that they accept the use of the metric system a bit more willingly when they see that it has uses outside of the classroom and laboratory.

In Montana there is so much to see that MICHAEL PAPICH, general science instructor in the Anaconda Junior High School, says he starts his classes by having the pupils just gaze out the windows. He quickly tells us, however, that it's not just day-dreaming.

We spend the first two or three days just gazing out the windows of the classroom. Within shouting distance and in clear view are wonderful examples of mountain formations, erosion, soil conservation, rock formations, and forests. The ensuing questions from the students are too numerous to mention; such as, how did these things come about? My type of window instruction is carried out through the entire year wherever the opportunity arises.

For the next few days the students give oral reports on where they spent their vacations. This, of course, calls for mention of everything that may be of scientific importance such as planetariums, aquariums, zoos, botanical gardens, geological formations, medical buildings, and a discussion of the Anaconda Copper Mining smelter which is right in our city. The response is always very good, usually 100 per cent, and is the first step in giving the child an opportunity to assert himself and contribute to the class discussion. This is all very informal with the idea of making the student feel at ease and less withdrawn.

The final step of the first week of general science consists of a period in the laboratory. Here the pupils see all of the equipment they will use during lab periods for the entire year, plus many specimens such as insect collections, plant life, an aquarium, maps, charts, etc.

I fully realize that I am blessed with a rather unique situation in having so much to look at from my classroom window, a well-equipped lab, and a free hand in teaching my course. To me, these things add up to a very desirable situation in which I hope that my type of teaching is getting results.

What about mathematics in physics? The next contribution gives a glimpse into the handling of this question as J. ROSS YOUNG treats it in the Cambridge, Illinois, High School.

"I'd take physics if it had no math." Have you ever heard that statement? Such a remark is often contributed by a student who should be the very first to register for physics.

Enrollments in physics are notably small. In the last ten years we have increased Cambridge High School's physics class enrollments by 40 per cent.

This is what has been done in our school. The very first day physics students participate in a walking tour about the high school building. Construction that specifically illustrates simple principles of physics is observed. This trip includes the home economics room, boiler room, gymnasium, office, and general class rooms. The following four days are devoted to elementary arithmetic as found in any eighth grade arithmetic book. Some time is devoted to the working of simple equations. Most students have had at least two years of high school math before physics, but they forget. Try these simple equations on your students the first or second day of the semester: $\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2}$, solving for R, or possibly this one, $\frac{V1}{V2} = \frac{T1}{T2}$, solving for T2; or possibly this one, $t = 2\pi \sqrt{\frac{l}{g}}$, solving for g.

We find that general principles of physics are understood, but solving simple problems become mysteries because of inability to remember the fundamental processes of arithmetic.

To tell us about his way of starting off in general science in the Fleming County High School, Flemingsburg, Kentucky, OWEN B. STORY goes back a few years and recalls the situation in which he started his teaching. This impressed him in a way which he recalls each year in beginning with new groups of students.

Eight years ago, I came to Fleming County High School to teach. Each day I stood in front of approximately 100 bright-eyed expectant 9th grade students. Many of them had had little or no regular class work in science.

They were assigned to a course called general science. Due mostly to the teacher shortage, very little had been done in general science except to read and recite the text material. It was up to me to organize the course in a way that would create and stimulate interest.

In the beginning I checked all of our laboratory equipment so as to locate and put in one place each piece of apparatus suited to the various units of the text. Then I made an order for some new equipment and at the same time I collected from many places used specimens that could be used to give vivid demonstrations in class. I tried to have a *real* example of as many things as possible that were mentioned in the text. If we were studying radio, when we took up the parts of it I had old tubes to show the grids, etc.

We had a science table in my classroom on which I would put several pieces of equipment that I planned to use in demonstrations during the next week or so. As soon as I would put out new things many students would gather round, look at each piece, and inquisitively ask, "What is this?" By the time we were ready for the demonstrations, interest in what I was going to show them had risen to a high pitch. For days and days, when my room was open when classes were not in session, large groups of students would continue to meet around the demonstration table; and, to my pleasant surprise, boys and girls from the upper grades would come to my room and manifest a great interest in the exhibited experiment or demonstration. It was an ordinary thing to hear some student say, "I wish I had taken general science."

The continuing interest of students in demonstrations and pieces of apparatus was a great incentive to me to do more along this line. At the beginning of each school year, as early as possible, I try to put in sight things that attract student attention. I also do a few novel experiments during the first few days. There are many that require very little time or expensive equipment. For example, one of my favorites uses two little cork balls made from stoppers. I hang them up on threads and show how they react to an amber rod rubbed with wool or a glass rod rubbed with silk. Of course, at that time I do not go into static electricity, but I try to plant the thought that we do see interesting things in the course from which students can find answers to many of their questions.

Space does not permit elaboration, but we also make use of films, film-strips, science magazines, living specimens, pamphlets, reference books, and much material supplied by pupils as the course progresses.

How about chemistry? Well, we have one contributor writing in this field of instruction. He is ROBERT MOLKENBUR, chemistry instructor in the Central High School, St. Paul, Minnesota.

I feel that chemistry is a wonderful place to show how the methods of science are not only useful but a "must" for progress. Therefore, I take time at the beginning of the school year to demonstrate the methods of science in action in industry.

We start out by examining a manufactured article such as a plastic toy, a sample of colored cloth, or a sanding disc, and then trace the steps taken in solving a problem pertaining to the article. Let's

(Please Continue on Page 140)

Cooperative Activities
IN ELEMENTARY SCIENCE

By ESTHER SILVERSTEIN

First Grade, Laboratory School, Indiana State Teachers College, Terre Haute

THE PROJECT described in this article really began as an idea several years ago when I admired some beautiful plant arrangements in a Chicago hotel. Since the idea matured into reality, our first grade room has had an attractive cart for a garden during all seasons of the year. This has motivated our study of science.

In class discussion of the idea, it was decided that a wheelbarrow would make a good flower cart. Two of our practice teachers made the framework which the children could finish. This consisted of sturdy bottom and floor supports to withstand the weight of the soil and the effect of excess water.

At about this time two college juniors preparing to become teachers joined our group in order to work with young children in a science project and thus gain valuable, first-hand experience. One of the students—a two-hundred pound college boy—stood at my desk shaking at the prospect of his ordeal. He actually was afraid he could not cope with the boys and girls. It turned out, however, that once "in the swim" his easy manner made a delightful time for all.

The children divided into committees with chairmen for the different jobs they had decided to assume. There was a "hammering committee" to build in the shelves, attach the top supports, and put on the wheels (see picture). The "wheel committee" with help drew and cut the wheels from a mattress box and then painted them with tempera. The "oil paint committee" painted the built-in shelves, the supporting posts for the top border, and twenty coffee cans for plants which the youngsters had brought in. A "design committee" cut decorative scallops from white drawing paper. The "planting committee" filled the coffee cans with soil obtained from a florist, chose the seeds to plant from our packaged seed box, and with the help of the student teacher read and followed the directions on each package. Each planting was properly labeled.

The practice teacher and the college juniors helped the children with jobs which were too difficult or somewhat dangerous for them to do. Included were all heavy lifting and close supervision of sawing and hammering. The juniors had a wonderful time (they worked with the group two afternoons a week until the project was finished) and they appreciated more fully the implications of their own class work in the light of this experience.

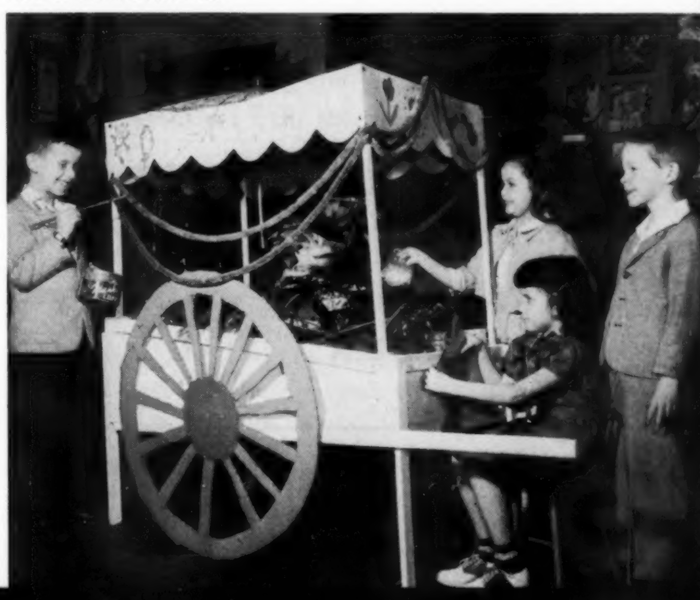
The children were inspired to write a story about the cart. They wrote the following:

> The cart is pretty.
> It has blue wheels.
> It has red hubs.
> It has a white body.
> We made it red white and blue.

The practice teacher took over at this point and used the cart as the basis for some science work. Into a can of wet soil she put one of the plants the children had grown and covered it with a lid. Into another can of wet soil she put another plant, but this time she left the lid off. After the plant in the can with the lid had died, she passed it around so that the students could see the yellow leaves. After some discussion, the class decided that plants need sunshine as well as water and food—just like we do ourselves. Again the little gardeners and scientists wrote out their new learnings (assisted, of course, by the guidance of the practice teacher).

One morning the college professor of science methods invited the five committee chairmen to

PHOTO BY MARTIN'S PHOTO SHOP



come into one of his classes and tell what happened in the building of the cart and the planting of seeds. How they all worked together getting their reports ready! The children were at first spellbound in front of the college group but soon relaxed to tell of their experiences. Unprompted, one child "thanked the college students for their help during the project. When the college students thanked the first-graders for themselves being such "good helpers," the children were surprised and then pleased to realize that they had helped "college boys" to learn. They talked about this when they came back to the classroom—and also how "you have to talk loud so you can be heard in that big room."

The flower cart has led into the study of other worthwhile subjects. The weather and its influence on plants became one of these when some plants suffered from an unexpected freeze. Weather changes were tabulated and later a temperature chart was kept using readings from our own thermometer. We made this chart just like the one we used to keep track of the room's purchases of bonds and stamps.

This project was one in which the little ones helped the adults and the adults worked with the little ones on something that everyone wanted. We oldsters felt that we were planting seeds not only that would grow and flower, but also the seeds of democratic action through cooperative activities.

STUDENT EVALUATION OF TEACHING PROCEDURES IN BIOLOGY

By DR. LEONARD WINIER

Assistant Professor of Biology

Assisted by DR. J. B. PAUL

Director of the Bureau of Research, Iowa State Teachers College, Cedar Falls

IN EDUCATIONAL CIRCLES we find two quite different points of view as to what constitutes effective teaching procedures:

(1) that in schools and colleges the learning-by-doing procedure results in the most effective functional learning. This implies that students help determine the objectives, organization, content, and class activities that make up the course in which they are enrolled. Student planning and group work are thought to be essential for functional learning.

(2) that in schools and colleges teaching procedures which result in the mastery of well organized subject matter are to be preferred. That such mastery of subject matter provides the needed materials and processes for utilization in most effective living. This implies that the instructor determines the objectives, organization, content, and class activities that go into the course. Not uncommonly, the lecture is employed as the main teaching device, and in many cases, the students study from a single textbook. This is particularly true in the science field at the college level.

In the first instance we learn to do by doing; in the second instance we learn to do by utilizing knowledge and habits gained in the learning situation.

In this study the writers were interested in learning the reactions of the students enrolled in the Biological Science course at Iowa State Teachers College to the two teaching methods just mentioned. In the group method, the students assisted in the selection and planning of problems for study within the broad areas required of the course. The students participated in preparing class reports, leading discussions, and carrying out a variety of class activities. In the lecture-discussion method, the instructor laid out the detailed content areas to be studied and made definite, day-to-day reading assignments. The lecture method was followed closely with some time provided for class discussion.

PROCEDURE

Two classes in the Biological Science course in the general education program at the college were used in the study during the Winter term 1952-53. The classes were taught by a single instructor. One class started with the group method of instruction

and continued in this manner for half of the college term. The other class started with the lecture-discussion method and followed this pattern to midterm. At midterm, the teaching procedures were reversed in the two classes. In this way all of the students in both classes had an opportunity to study biology under two very different teaching situations.

The two groups of students were about equal in mental ability, interests and grade point averages as determined by the ACE psychological scores, the Kuder Preference scales, and the registrar's records.

Due to the science sequence requirements of the general education program at the college, the broad content areas had a common basis for both classes. Human origin and development, heredity, and evolution were the general subject matter areas considered in the course. It was within these three areas that students assisted with the selection and planning of problems that went into the course under the group method. The following outline is suggestive of the nature of the course under the group method:

Exploration of the problems in the area of human origins and development.

Problem Area I The Sex Hormones and Glandular Imbalance

Outline
- Survey of the ductless glands in the human
- The pituitary gland and its bearing upon sexual development
- The role of the thymus gland upon sex development
- Sex determination
- The sex hormones and their influence upon physical growth and development
- The use of cortisone in the treatment of sex reversal

Class Activities
- Interpretation of charts and diagrams dealing with endocrine functions and sex reversal
- Dissection of the frog for study of the endocrine glands
- Group report on sex determination
- Group report on the use of cortisone in the treatment of sex reversal
- Written report on special readings

In the lecture-discussion method, the following outline is suggestive of the material covered in the early part of the course:

Human Origin and Development

The general pattern of animal reproduction
The reproductive system in the human
The hormones in human reproduction
The ovarian cycle
Early embryological development
Embryonic membranes and placental relationships
Reproductive potentials and social implications

THE INSTRUMENT

An evaluation instrument designed to elicit responses from the students regarding teaching methods was administered to both classes at the close of the college term. Students were asked to state their preference in teaching method. Data were collected on the reasons for their preference by having them respond to a checklist. This checklist consisted of twenty statements which pointed out the main values that seem inherent in the lecture-discussion procedure, and twenty statements which pointed out the main values that seem inherent in the group method. The statements used in the instrument were based on the writers' experiences in working with students over the years with both teaching procedures. (A copy of the evaluation instrument will be sent upon request.)

FINDINGS

Fifty-one students enrolled in the two classes expressed their reactions to the teaching methods through the evaluation instrument. The following results were obtained:

Class	*Favor group method*	*Favor lecture-discussion*
Class A	9	13
Class B	18	11
Total	27	24

Further results obtained with the instrument pointed out the reasons for the students' preference of one method over the other. The four statements most frequently checked by the students favoring the group method are as follows:

Statement 5	It makes students more self-directive and stimulates independent thinking
Statement 11	The student learns more if he has to do the work
Statement 8	It requires wider reading on the part of the student
Statement 17	The student learns more because he remembers better the things he does himself

The four statements most frequently checked by the students favoring the lecture-discussion method are as follows:

Statement 3	More material can be covered
Statement 15	The instructor can get across de-

tails that are important for understanding biology

Statement 7 The instructor can better emphasize the main ideas to be gained in the course

Statement 6 The materials are better organized if the instructor lectures

Students were permitted to write personal comments in expressing their opinions on teaching methods. Thirty different kinds of comments were made by each of the two groups of students, i.e. those favoring group methods and those favoring lecture-discussion. The most common remarks made by the group method students are as follows:

No. of Responses	*Comment*
11	More interest is created in group work
7	The two methods should be combined since good points are found in each procedure
6	Learned more under the group method
3	Helpful to us as future teachers

The most common remarks made by the lecture-discussion group are as follows:

No. of Responses	*Comment*
9	Learned more under lecture-discussion method
5	The two methods should be combined since good points can be found in each
4	Student reports are often poor
5	Time was wasted in the group method

A general reaction on the part of both groups of students seemed to favor a kind of compromise situation in which the main values in the two teaching procedures could be put to use. Whether or not the students have thought through the feasibility of such a combined approach is questionable since there may be a serious loss in attaining certain objectives in a compromise situation where half-way measures must be resorted to. The students by and large felt that the group method holds more interest for them. Also, they expressed the opinion that they learned best the specific tasks that they performed.

Responses of students to the lecture-discussion method showed that they found it easier to prepare for tests, take notes, and learn factual material than by the group method. In other words, the lecture had a convenience factor for the student. On the other hand, students were aware that this method of teaching was not completely satisfactory since it tends to be dry, and places too much emphasis on memorization.

OBSERVATIONS AND CONCLUSIONS

1. In view of the fact that the lecture-discussion method is overworked at the college level and since students tend to resist changes in teaching methods that they have become accustomed to, it was gratifying to learn that over half of the students preferred the group method over lecture-discussion. It would seem, then, that an instructor interested in moving beyond conventional teaching procedures can do so safely without serious resistance.

2. We know that college students are very much conditioned to the idea that the chief requirement of most courses is learning a body of factual material. The examination program for the most part kindles this kind of feeling in the students. Because of this, there was some difficulty in weaning the students of the notion that acquisition of factual material was not the all-important value to be gained.

Perhaps instructors resort to tests on factual information because student growth in social attitudes and independent thinking is such a slow and gradual process, and so difficult to measure. There is a need at the college level to employ teaching procedures that will help the students to see that the acquisition of factual knowledge does not necessarily deserve first position as a learning outcome.

3. Since the college students will go out and teach as they are taught, it is important that they receive a variety of experiences in the kind of teaching methods that have proven themselves at the secondary level. The study showed evidence that the group method was being largely over-looked at the college, at least in the science area.

4. The feeling on the part of the writers was that class rapport seemed much better under the group-method than under the lecture-discussion method. This can probably be accounted for by the fact that the students had a greater personal interest by having the opportunity to assist in planning the course under the group-method. And too, the interaction of students and instructor in class procedure conformed more with the exercise of the democratic process than did the more autocratic means employed in lecture-discussion.

5. Lastly, perhaps the greatest difficulty in introducing group techniques into our courses does not rest with the students but rather with the instructor. This approach certainly was demanding, and challenged the instructor far more than lecture-discussion. Less security is experienced by the instructor when students can freely express their ideas, and course content is likely to be extended beyond the conventional subject matter boundaries in which the instructor has been trained.

A Laboratory Activity in Astronomy

By RICHARD H. LAMPKIN

State University, College for Teachers, Buffalo, New York

Condensed from a presentation to the Junior High School group of the Science Section of the Western Zone meeting of the New York State Teachers Association in Buffalo, New York, October 24, 1952. Assistance of William Chalmers, formerly of State Teachers College, Upper Montclair, New Jersey., is acknowledged in design and construction of the apparatus. Assistance of Norman Truesdale, Audio-Visual Production Laboratory, State University, College for Teachers, Buffalo, is acknowledged in planning and making the photographs.

I am primarily concerned now with the preparation of teachers for elementary schools. Therefore, I am pleased and gratified to be asked to present a demonstration for experienced teachers at the junior high school level.

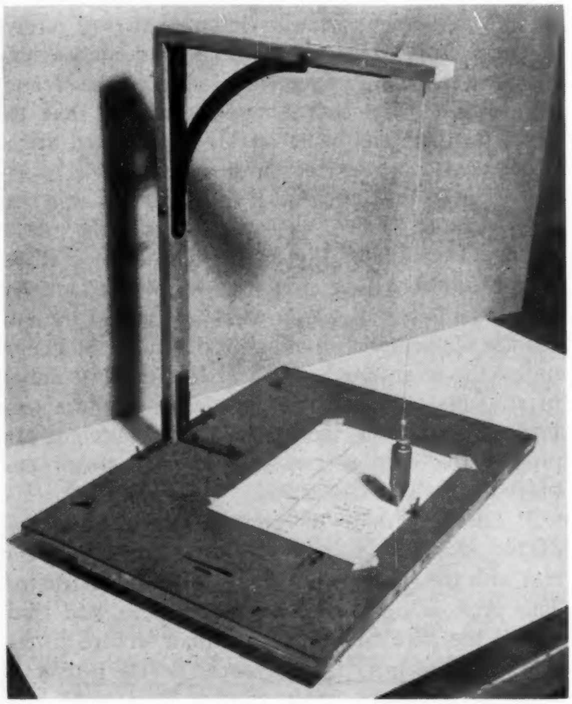


FIGURE 1

General view of apparatus. Wing nuts on the supporting brackets make it easy to take the apparatus apart for convenient storage in small space.

I have elected to present a laboratory activity in astronomy. It should be considered in the following frame of reference. We wish students to acquire certain concepts such as changes in the apparent place of the sun (through the hours, days and seasons), clock time and calendar time, the coordinate system using latitude and longitude, and how to measure the latitude and longitude of any place where we happen to be. All too often we merely look at pictures, or talk or read about such concepts. These are good, but possibly we can find other suitable teaching-learning activities. The apparatus presented here is only a development of the shadow stick which has been used in primary grades for many years. It has been used here to present some stories to be read in sunlight and shadows—some astronomical and geographical concepts. You, teachers of junior high school students, may use as much or as little of it as you think wise.

Set up the apparatus as shown in Figure 1 where the sun can shine on it most of the day, with the plumb-line support on the north or shadow side of the base, and preferably shielded from the wind. Before making observations, level the baseboard by means of the leveling screws provided; the level vials show when it is level. Attach heavy drawing paper to the baseboard with Scotch Tape or thumb tacks. Throughout the day, mark the successive positions of the shadow of the nodus (Figure 2). Write the clock time of each shadow next to the position marked. Draw a line from the point directly beneath the plumb bob to each shadow position. Also, draw a smooth curve through the several shadow positions. An example of this record is shown in Figure 3. The geometry of the shadow is diagramed in Figure 4.

Some of the concepts which might be developed and measurements which might be made through this activity are outlined below.

(1) The *real sun* is that which we see; it emits light and can cast a shadow. The *mean sun* is an imaginary sun which keeps perfect time and by which we regulate our clocks; it does not cast any

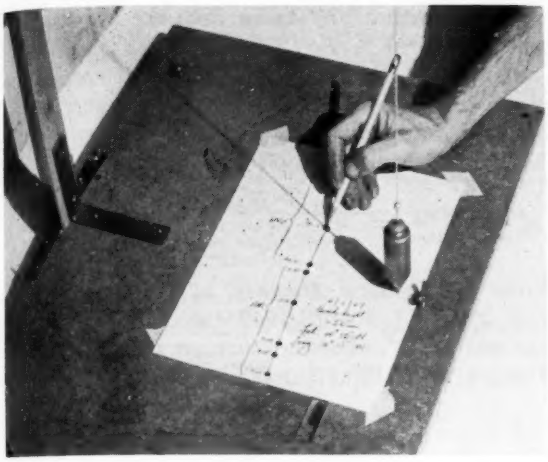
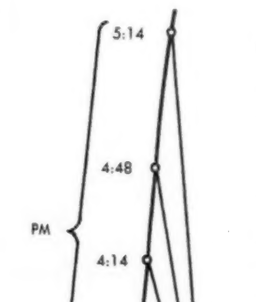


FIGURE 2

The nodus is a bead, or a core from a cork borer. It casts a shadow on the paper which shows where the sun is—how high above the horizon and in what geographic direction. The path of the shadow during a day can be used in answering such questions as what season it is, what instant real solar noon comes, what direction true north is, and where the observer is (latitude and longitude.)



shadow. The difference between real sun time and mean sun time is the *equation of time.* (See Equation (a).)

(2) The *altitude and azimuth of the sun* change throughout the time of daylight. Its altitude is zero at sunrise, increases to a maximum, and then decreases to zero again at sunset. Its azimuth changes as the sun rises roughly in the east, passes to the south, and sets roughly in the west.

(3) *Real solar noon* is defined as the time each day when the real sun is highest in the sky (and shadows are shortest) and when the real sun is on the observer's meridian.

FIGURE 3

Successive positions of the shadow of a nodus which was 2.00 in. vertically above the point marked with a cross in a circle, on 2 April 1949, in Montclair, N. J., at Latitude 40° 50′ N. Longitude 74° 13′ W. Scale: 1″=4″.

(4) At real solar noon, shadows lie ***true geographic north*** of the objects which cast them. Thus, in Figure 3, true north lies through the shortest shadow; the arrow showing north has been drawn so.

(5) From here on let us consider that Figure 4 is drawn for real solar noon. Then angle CAB is maximum and is the *altitude of the sun when it crosses the observer's meridian;* as measured on the original of Figure 3 this altitude was the angle whose tangent is 2.00 in./1.50 in., the angle whose tangent is 1.33, or 53° 8′. (Tangents of angles can be found in tables of trigonometric functions.)

(6) The *standard time of real solar noon* can be found by reading the shadow record in Figure 3. If no observation was taken at the instant when the shadow was shortest, the time for it can be estimated from the curve and other times recorded.

(7) If the longitude is known, the *equation of time* can be calculated. The following relations hold for any place in west longitude. In Equation (a), each time must be expressed in the same scale. In Equations (b)-(d), longitude is expressed in degrees.

(a) Equation of time = Time of real solar noon at the place − Time of mean solar noon at the place

(b) Standard time = Local mean sun time − 4 min. × (longitude of standard time meridian − longitude of the place)

(c) Standard time of real solar noon at the place ≈ Standard time of real solar noon at the standard time meridian − 4 min. × (longitude of standard time meridian − longitude of the place)

(d) Standard time of real solar noon at the place ≈ Standard time of mean solar noon at the standard time meridian + Equation of time − 4 min. × (longitude of standard time meridian − longitude of the place)

In the example of Figure 3, it was mere coinci-

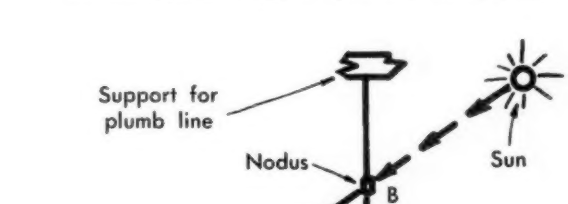


FIGURE 4

Geometry of the shadow; the altitude of the sun is angle CAB whose tangent is a/b.

dence that *the time when real solar noon was observed* was 12:00 noon EST. Consider the several quantities on the right-hand side of Equation (d). By definition, the standard time of mean solar noon at the 75th meridian is 12:00 noon EST. Assume that we know the equation of time; on this day, 2 April 1949, the real sun was $3^m\ 37^s$ behind the mean sun (this is taken from the *Nautical Almanac*)[1]. The map shows my former home in Montclair, N. J., to be 47′ east of the 75th meridian (Longitude 74° 13′ W). When we substitute these values in Equation (d) we get

$$\begin{aligned}\text{Standard time of real solar noon at Montclair, 4/2/49} &\approx 12^h\ 0^m + 3^m\ 37^s - \left(4 \times \tfrac{47}{60}\right)^m \\ &\approx 12^h\ 0^m + 3^m\ 37^s - 3^m\ 8^s \\ &\approx 12^h\ 0^m\ 29^s, \text{ or } 12^h\ 0^m\end{aligned}$$

within the limits of observation.

If we assume the longitude of the observer's place to be known, then the *equation of time* can be found by a rearrangement of Equation (d).

$$\begin{aligned}\text{Equation of time} &\approx 12^h\ 0^m - 12^h\ 0^m - 3^m\ 8^s \\ &\approx 3^m\ 8^s\end{aligned}$$

[1] U. S. Naval Observatory. *American Nautical Almanac for the Year 1949*. Washington, D. C.: United States Government Printing Office, 1948. 318 p. (A similar almanac is issued for each year.)

compared with $3^m\ 37^s$ taken from the *Nautical Almanac*.

(8) If the sun's declination when it crosses the observer's meridian is known, *the observer's latitude* can be calculated. Figure 5 shows the basis for the following equation:

$$\text{(e)}\quad \text{Latitude of the observer's place} = 90^\circ - \left(\text{Altitude of the sun when it crosses the meridian} - \text{Declination of the sun}\right)$$

From the *Nautical Almanac*, at 12:00 noon EST ($17^h\ 0^m$ GCT), 2 April 1949, the declination of the sun was 4° 59′. For the situation shown in figures 3 and 4, then, Equation (e) becomes

$$\begin{aligned}\text{Latitude of the observer's place} &= 90^\circ - (53^\circ\ 8' - 4^\circ\ 59') \\ &= 41^\circ\ 51'\end{aligned}$$

compared with 40° 50′ shown on the map.

(9) If the Greenwich Hour Angle (GHA) of the sun when it crosses the observer's meridian is known, *the observer's longitude* can be calculated. The GHA of the sun is the angle measured from the meridian of Greenwich westward to the hour circle of the sun. The longitude of the observer is precisely equal to the GHA of the real sun whenever the observer has real solar noon; that is, whenever the real sun is on the observer's meridian.

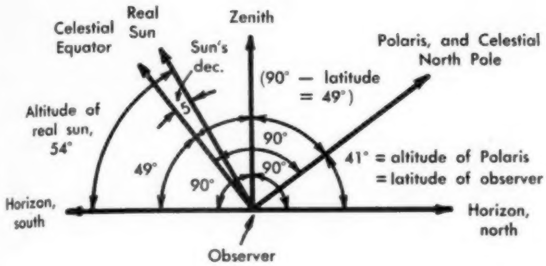


FIGURE 5

Diagram in the plane of the observer's meridian, Montclair, N. J. (Latitude 41° N), at real solar noon, 2 April 1949. The position of the observer has been marked.

From the *Nautical Almanac*, at 12:00 noon EST ($17^h\ 0^m$ GCT), 2 April 1949, the GHA of the sun was 74° 6′. This was also the calculated longitude of the observer, compared with a map value of 74° 13′.

(10) If shadow records like Figure 3 have been made for each of several days throughout the year, the *sun's daily paths in the sky at various seasons* can be compared. In general, a composite of the shadow records will look like Figure 6. The longer shadows in winter show that the sun is then lower in the sky; the shorter shadows in summer, that the sun is higher. The straight shadow path on March 21 and September 23 shows that the sun rises directly in the east and sets directly in the west on those days. The morning shadow on December 22 lies to the north of west; therefore, the rising sun must be to the south of east. The morning shadow on June 21 lies to the south of west; the rising sun must be to the north of east. Of course, a quick glance at the sun will confirm such shadow observations. But marking the shadow paths is an easy way to make a permanent record of the seasonal variations in the sun's daily path through the sky.

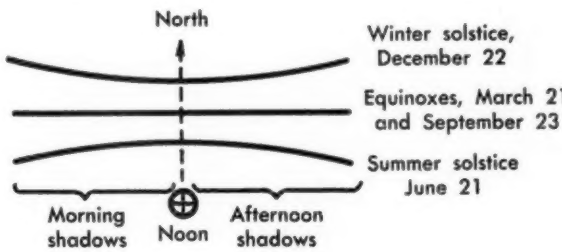


FIGURE 6

Range of shadow records (lines drawn through successive shadows of the nodus) throughout the year.

The apparatus in this laboratory activity is simple; essentially it is a plumb line with nodus suspended over horizontal drawing paper. The apparatus has been used in observing the sun through the shadows which it casts. Buffalo weather seems to give more of the shadow than the light, but it would be difficult to find a more pervasive aspect of environment than sunlight and shadows. Concepts such as shadows, sunrise and sunset, forenoon, noon and afternoon, geographic north and south, standard time, latitude and longitude, and seasons have ordinarily been introduced and used long before students reach junior high school. If the development which has been suggested here seems extreme, we may be forced to admit that perhaps we have been using the words without understanding the implications of them with respect to the shadows cast by the sun. The concepts do seem important.

Science teachers who are interested in a tuition-free summer session should contact Mr. Harold B. Dunkel, The University of Chicago, Chicago 37, Illinois. Graduate credit is available. The session features "demonstration sections" taught by outstanding members of the University faculty. College and high school teachers are eligible. In awarding scholarships special preference will be given to groups of teachers representing a field of study within a single institution. The session is scheduled for June 28 to July 30.

Why Study ENGINEERING?

By ROBERT L. MESERVE

To THE GREEKS this era would be an age of miracle. For in the twentieth century, technology has brought to life what ancient Greece dreamed of in myth and make-believe. It is startling even now to realize that in the span of a few generations man has met the challenge of Nature and achieved the once impossible. He flies—so fast in fact the sound of his flying lags far behind. He dives beneath the surface of the sea in man-made fish and lives to tell about it. His buildings touch the clouds and hold within their walls a tropic heat in February. Each home is tapped into a cool clear spring of water—and a push button world of light he has when sunlight disappears. He talks across a continent with the ease of talking across a room—and think of it—within his home he watches what is happening a thousand miles away. Fantasy perhaps to you, Grecian—but modern man takes for granted these engineering miracles so numberless are the conveniences that enhance, protect, in short—make possible, his daily living.

To even a skimmer of history books the outstanding monuments to the society of each bygone era are its triumphs in technology. From the Pyramids of Egypt to the atomic submarine these achievements stand out in relief against civilization's patient pattern of progress.

What is engineering, that it must leave a mark so vivid in the course of human history? It embraces all his ventures in heat and light, power and production, communications and construction—in short almost every aspect of his daily living. It is an honest study devoted to an understanding of man's physical needs and the development of a means for their solution. The major concern of engineering is the ever-constant battle to harness and control the forces of Nature—to make of it an ally rather than an adversary. Its foundation is the effort to help man live—and modern engineering adds the word "comfortably." It is an exacting profession and to enter the realm of professionalism, its students must possess the love for scientific inquiry.

It is an ever-expanding field of investigation—its aspects so numerous that no man can hope to become proficient in more than a small segment of the art. Consequently, dating from about a century ago, when specialization introduced the civil engineer as the counterpart of the military engineer, the profession has been divided into a formidable list of specific types of engineer. All uphold the basic principles of engineering but the investigations of each are concentrated in a particular category of problems. Roads, bridges, canals, airfields, buildings and the science of land measurement are the realm of civil engineering.

The first men to be called engineers were military scientists involved with the development of weapons and fortifications. There are, besides these two, perhaps four additional major branches of engineering. Under these fall all the aspects of technological inquiry. Electrical engineers work with power plants and design electrical machinery; other machinery and the analysis of the strengths of various materials are the bases of mechanical engineering; efficiency in industry calls for an industrial engineer; and the chemical engineer specializes in production processes and the manufacture of chemicals. A brief list of the lesser groups of engineers, all basically advocates of one of the above branches, would include those specialists in mining, heating and ventilating, refrigeration, structural design, hydroelectric power, sanitation, communications, traffic control, illuminating, automotives, aeronautics, acoustics, agriculture, architecture and finally those who sell engineered products or processes, the sales engineers. It denotes a world of diversified interests but all of them are devoted to one common purpose of performing a needed service to mankind through the effective use of materials and energy.

America has properly been called the Land of the Engineer. Probably nowhere in the world has the progress of technology been afforded the impetus that has existed with the birth and subsequent development of this great pulsing giant of a continent with all its resources, its variety of climates, and

The Engineering Societies of New England, Inc. established an essay contest for young engineers in 1948. The purpose was to encourage thought among young members of the constituent societies with regard to their professional status and responsibilities and to provide recognition for meritorious achievement by young engineers. In 1954 it was decided that the contest would be planned so as to contribute to the career information literature available for science teachers to pass along to their students. NSTA was invited to cooperate by publishing the winning paper in *The Science Teacher*. We were happy to accept the invitation.

Three papers entered in the contest were chosen to receive awards. Third prize of $20 went to Mr. Romuald J. Mack, an engineer with the Meter and Instrument Division of the General Electric Company in West Lynn, Massachusetts. Second prize of $30 was awarded to Mr. John H. Headapohl, employed by the Linde Air Products Company, Natick, Massachusetts.

The first-prize paper ($50), which is printed herewith, was written by Mr. Robert L. Meserve. Mr. Meserve is employed by the firm of Whitman and Howard, civil engineers, of Boston, Massachusetts. A native of Medford, Massachusetts and a graduate of Medford High School (1946), he studied civil engineering at Northeastern University under the cooperative plan. During this time he gained work experience at Whitman and Howard, first as a rodman and later as a transitman. Called to active military duty immediately after graduation in 1951, he soon became a commissioned officer with the 2nd Engineer Battalion of the 2nd Marine Division. His release to inactive duty came in April, 1953. He has been in his present employment since that time.

Mr. Meserve lives in North Wilmington, Massachusetts, with his wife, June, and six-months-old son, David. He is a member of the Boston Society of Civil Engineers. Says his outside interests include "writing and an occasional below-average round of golf."

most important its democratic way of life—which has always promoted the free exchange of ideas among men. To the engineer it has been a Utopia of opportunity since the first tree was felled with a resounding echo on the eastern seaboard. In the field of transportation alone, the results are indicative of American engineering genius, for clipper ships were nursed in America, as was the locomotive, the automobile, the airplane; truly it is the land of the engineer.

As America has only recently reached maturity so has the engineering profession itself but lately come of age. With the complexity in technological advancement, the profession of engineering is finally emerging in the prominence commensurate with its responsibilities and achievements. Engineers now exert a compelling influence in every walk of life; tapped by government, by business, and by industry, they help direct the efforts of each in harmony with sound engineering economics. Awakened to the primary importance of technology in this modern civilization, the world now gives the engineer that professional esteem formerly reserved for medicine, theology, and law.

From the foregoing it should be evident that the study of engineering is a worthy venture leading to a worthy career. The demand for engineers has mushroomed since the end of World War II. A number of contributing factors have been the cause of this; the expanding scope of technology creates the need for engineering minds as never before; the depression of the thirties and the lesser birthrate dating therefrom has reduced college enrollments year by year since 1949 and the reduction in the number of engineering graduates is being felt; increased commitments in foreign lands swell the call for engineering talent. The present competitive market for young engineering graduates, although not enviable from the employers standpoint, presents a pleasant picture to the job-hunting engineer. This demand extends into every field where technology plays a part—industry, utilities, research, government bureaus, teaching, and private engineering practice. As an indication of the relative demand today for young engineers as compared with that of yesteryear, the *American Engineer* magazine gives a specific example in aeronautics with the statement that the F-86 Sabre Jet fighter plane requires twenty-seven times the engineering man hours in its manufacture than were necessary for the P-51 Mustang of World War II. Such is the complex progress in technology. As further proof of the demand in industry *Collier's* magazine recently said, "Big business is literally begging fledgling engineers to

come to work for it. Hungry scouts from airplane, auto, chemical, oil, utilities and steel companies have been sweeping the nation's campuses, exercising all the salesmanship at their command, in an unprecedented drive to recruit new engineering talent to fill American industry's pitifully sparse ranks, and there is no sign that the insatiable demand will abate."

Opportunity is growing for engineers to fill executive positions in ever-increasing numbers. Industry has discovered that its present managerial responsibilities may best be handled by technically proficient men and the engineers are looked to as having the necessary background. In politics there is an increasing demand for technologists in the field of town management. Since many major municipal problems are of a technical nature, such as public works programs, housing, sewerage, water works, roads, and utilities, the engineer with training in finances and government is well equipped to fill the director's position. It is because of this recent calling that many engineering schools countrywide have incorporated into their curricula major courses in engineering and town management.

In choosing a career the consideration of almost every individual is necessarily an analysis of a number of fields in which he is interested, and through a process of thoughtful elimination arriving at a decision as to which endeavor may offer him the most as regards opportunity, compensation, security, and the all important job satisfaction. The foregoing paragraphs establish the fact that opportunities in the various branches of engineering are unlimited.

It is of course axiomatic that the present and apparently lasting increase in the demand for engineers would carry with it expanding compensation scales for engineers of every turning. Aside from the fact that engineers are being recruited for executive positions in many fields, an overall analysis of the earning power of engineers depicts an upward trend from what is already a substantial base. As proof, the statistics gained in a recent survey of registered professional engineers conducted by the National Society of Professional Engineers concerning income show that of over 12,000 engineers contacted, more than half had incomes in excess of \$7850 in 1952. Only one in ten had salaries in the \$5000 a year bracket; twenty-five percent of the entire group earn more than \$10,000 yearly. Therefore it is evident that engineering training and a few years' apprenticeship in the field will meet with adequate material compensation.

There are other no less important values to a career in technology for the very creative atmosphere of engineering fulfills the more basic human needs. Creation is the prime mover in all its branches of endeavor whether it be the building of an aerial skyway above a humming metropolis or the search for efficiency in the manufacture of the smallest machine part. Engineering meets the human craving for responsibility—for the desire of every individual to become a necessary component of society. These benefits cannot be decimated to an accounting in dollars and cents. The only scale for measuring such intrinsic values may be found in the job happiness resulting from their fulfillment.

All engineering students do not become members of the profession upon acceptance of the degree they have earned. This is true in any course of study. Only a percentage of the graduates of law school become lawyers; many business school alumni find non-business occupations more to their liking. Regardless of the eventual career an engineering student follows, he will find himself mentally equipped with a training valuable in any endeavor. He has learned to think—his powers of reason and logic have been developed to a finer point than might ever be attained elsewhere; and like the engineering graduate who becomes an engineer, he will never regret that study.

As long as man has the urge, the drive, toward accomplishment in the furtherance of humanity, the frontiers for technology and its engineer pioneers will continue to expand and develop—the call for engineering minds will never diminish. Few professions today offer the urgent challenge to young manhood that emanates from the problems confronting today's and tomorrow's engineers.

Mankind will continue to need food, shelter, warmth, and machinery, and in a world faced with dwindling natural resources, the science of engineering has never assumed greater expediency. Technology is ever searching for the solutions to man's eternal problems. If the answers can be found, the engineers will find them.

PREDICTING HIGH SCHOOL SCIENCE ENROLLMENTS FOR 1958 AND 1968

By JOHN H. WOODBURN

Assistant Executive Secretary, National Science Teachers Association

HOW many new classrooms, laboratories, and science teachers will be needed in 1958? in 1968? According to the latest national survey, 66 per cent of all ninth grade students enroll in general science, 75 per cent of the tenth grade in biology, 39 per cent of the eleventh grade in chemistry, and 28 per cent of all seniors enroll in physics.

Carefully kept records in Ohio extending back through 1926 show that aproximately 85 per cent of the annual birth crop appear fourteen years later in the ninth grade, 77 per cent enter the tenth, 66 per cent the eleventh, and 59 per cent stay on through graduation.

If we assume (1) that conditions in Ohio are representative of those in the nation, (2) that the holding power of the high school will remain as it was in 1948-52, (3) that science enrollments will remain at the 1948 rate, and (4) that the Ohio birth rate continues to be 4.9 per cent of the national total, science enrollments in 1958 and 1968 can be estimated from the national birth crop of appropriate years. These estimates are shown in the table below. The same predictive formula was used to show enrollments in 1943, 1948, and 1954. The figures in parentheses show per cent of 1954 enrollment.

This predictive scheme can be applied to the national picture more appropriately than it can be used to predict the effect of increased enrollments in any one school system. There are 15,600 high schools enrolling between 25 and 200 students. Taking the average enrollment of about 100 students and applying national data, the science program would consist of about 20 students in general science; 21 in biology; 10 in chemistry and 6 in physics. It would appear that the school could absorb a 50% increase in enrollment without requiring new sections. The only problems would be those involving increased physical facilities[1]—no new science teachers would be needed. However, in schools of this size, the curriculum is somewhat limited. For example, if general science is offered, it is likely that it would be a required subject. Since there would be thirty students in the ninth grade, any increase in enrollment would necessitate opening a second section. If biology was required in the tenth grade, there would be about 28 biology students. Again very much of an increase in enrollment would create a need for an additional section. In the larger schools, the problems arising from increased enrollment would vary with individual schools. There are about 5,000 schools with enrollments between 200 and 500 students, averaging 310. Consider the effects of a 20% increase in this size school, using national data. The science program would consist of about 62 in general science; 64 in biology, 28 in chemistry; and 17 in physics. If a school had been getting along with two large sections of general science and biology and one large section of chemistry, a 20% increase would create a need for an additional section of general science, biology, and chemistry with the subsequent addition of another science teacher. On the other hand,

[1] John S. Richardson, Editor, *Facilities For Science Instruction*, National Science Teachers Association, Washington, D. C. 1954. $5.50. (This 266 page report gives the latest information on the design and equipment in school laboratories).

HIGH SCHOOL SCIENCE ENROLLMENTS FOR 1943, 1948, 1954, 1958, AND 1968

YEAR	GENERAL SCIENCE	BIOLOGY	CHEMISTRY	PHYSICS
1943	1,340,000 (102)	1,423,000 (114)	651,000 (109)	421,000 (115)
1948	1,295,000 (98)	1,136,000 (91)	539,000 (91)	370,000 (101)
1954	1,317,000 (100)	1,252,000 (100)	595,000 (100)	365,000 (100)
1958	1,522,000 (116)	1,695,000 (135)	758,000 (127)	416,000 (114)
1968	2,480,000 (188)	2,499,000 (200)	1,090,000 (183)	675,000 (185)

if a school had already split its general science, biology and chemistry into smaller sections, they could absorb the 20% increase. To continue the illustration, in the very large school, it can be assumed that section size is maintained at very nearly maximum condition. An increase of 20% in enrollment would create a comparable need for new facilities, including teachers. If the total enrollment, for example, is 4,000 students, there would be about 760 seniors with 212 enrolled in physics. An increase of 20% would require at least 2 new sections, and 2 full-time physics teachers would replace one full and one part-time person.

Looking ahead 10 years beyond 1958, science enrollments would be practically double those of 1954. To predict the effects of this expansion is much more difficult than for an expansion of 20%. Either school plants will have to undergo major overhauls or many new units will have to be organized. How many new class rooms, laboratories, and science teachers will be needed to give 11,360,000 students the kind of instruction they deserve will depend a great deal on which of these alternatives predominates.

With enrollment size distributed as it was in 1946, and assuming that all science classes are assigned to "science" teachers, the nation would need 45,150 science teachers today. Of these, 20,600 would have to teach all of the sciences—11,950 would probably teach two sciences—and 12,600 would have full assignments of a single subject. Among the latter, there would be about 5,440 general science teachers; the same number of biology teachers; 1,575 chemistry teachers and 145 physics teachers. If school plants are enlarged, there will be more opportunities for full-time teachers. If new units are organized, more teachers will be needed who can handle a combination of subjects.

Currently, if we define a full-time teacher as one who handles five daily sections of thirty students each, a four-year high school needs a total enrollment of approximately 2,800 students to support a full-time physics teacher. A full-time chemistry teacher can serve a total enrollment of about 1,400 students. A total enrollment of 720 students will provide full-time jobs for a biology and a general science teacher. At this time, 85% of the nation's high schools have enrollments under 500. There is little doubt that the nation will need new science teachers who are adequately prepared in several subject areas in greater numbers than are currently being trained. Teacher training institutions are very slowly shifting their programs to allow teachers to receive adequate training in a variety of subject matter areas. Until this shift becomes more widespread, it is essential that new and old teachers be given in-service opportunities to broaden their training.

Changes in the per cent of high school students enrolling in the sciences would, naturally, affect the accuracy of these predictions. Unfortunately, there is a scarcity of recent national enrollments data. Those published by the U.S. Office of Education are for 1933 and 1948. In an attempt to estimate trends since 1948, data were obtained from nine of the nation's ten largest cities, a total enrollment of over 500,000 students. Nationally, between 1933 and 1948, physics enrollment dropped from 6.3 per cent of the total high school population to 5.4 per cent, chemistry remained stable at 7.6 per cent, biology rose from 17.9 to 19.7 per cent, and general science rose from 17.8 to 20.8 per cent.

For the nine large cities, similar figures for the five years including 1948 and 1952 were: physics—6.5, 5.8, 5.7, 5.9, and 6.0 per cent; chemistry—8.6, 7.6, 8.1, 7.9, and 8.4 per cent; biology—22.2, 21.3, 23.0, 22.4, and 22.5 per cent; and for general science—21.2, 23.9, 20.4, 20.8, and 21.2 per cent.

As was indicated earlier in this report, several assumptions underlie the scheme upon which these predictions are based. It will be interesting to compare these predictions with those made by other investigators who have used different but equally valid assumptions.

Bibliography

Bowers, Harold J., "Teacher Certification in 1953. A Statistical Summary of Teacher Supply and Demand." State Department of Education, Columbus, Ohio.

Rice, Mabel, "National Summary of Offerings and Enrollments in High-School Subjects, 1948-49." Federal Security Agency, Office of Education, Washington, D. C.

Johnson, Philip G., "The Teaching of Science in Public High Schools." Federal Security Agency, Office of Education, Washington 25, D. C. Bulletin 1950, No. 9.

N.E.A. Research Division, "Reports of the Annual National Teacher Supply and Demand Study." National Commission on Teacher Education and Professional Standards. National Education Association, 1201 16th St., N. W., Washington 6, D. C.

If You Attended the Chicago Convention—

What features would you retain in planning the 1955 convention in Cincinnati?

What features would you drop or sharply revise? Please give constructive criticism.

Whom would you recommend for major speakers among general educators, science educators, scientists, discussants of public affairs, etc.?

Your comments and suggestions, sent to the headquarters office, will be most welcome and appreciated. They will be turned over to the chairman of the Cincinnati convention, Miss E. Louise Lyons, Steubenville High School, Steubenville, Ohio.

Science Education 1954 . . .

A DIRECTORY of SUMMER WORKSHOPS and PROGRAMS of STUDY

This directory is intended to be a professional service to teachers of science in elementary schools, high schools, and colleges and to the cooperating institutions included in the listing. The brief descriptions (paid advertisements) give the name and location of the institution; the name, title, and address of the person to contact for further information; and special features of the graduate program in science education and of workshops, special courses, and other offerings scheduled for the summer of 1954. Please mention *The Science Teacher* when you write to any of these institutions. Let us know whether you would like to have this service continued on an annual basis. *Editor.*

CALIFORNIA

SAN FRANCISCO STATE COLLEGE, San Francisco. Stanley W. Morse, Chairman, Science Division; or Robert Stollberg, Associate Professor of Science and Education; or Charles E. Burleson, Assistant Professor of Science and Education. Course offerings lead to Masters' Degrees in Physical Science or Biological Science; many designed or selected specifically in terms of value to science and mathematics teachers in public schools. 1954 summer: *Workshop in Elementary School Science; Mathematics in the Elementary Schools; Workshop in Mathematics for Teachers; Elementary School Science for Teachers; Seminar in Natural Science; Geology in the Western United States; Recent Advances in the Physical Science; Workshop in Junior and Senior High School Science; Nature Study; Natural History of California.*

SAN JOSE STATE COLLEGE, San Jose. William Sweeney, Dean of Summer Session. *Special Problems Workshop (Sci. Ed. 180S).* Exploration of possibilities for science in the elementary school. Correlation with social studies, the development of special learnings, and science for hobbies and special interests; will deal with course content, grade level placement, materials and methods, books and references, audio-visual aids, and community resources; provision for observation of teaching. 6 units.

COLORADO

COLORADO STATE COLLEGE OF EDUCATION, Greeley. Donald G. Decker, Chairman, Division of the Sciences. Courses for elementary and secondary science teachers: *Improvement of Science Instruction; Special Problems of Science Instruction; Seminar in Science Education; Field Science,* subject matter and methods, visit fifteen different environments. Special offerings for 1954 include: (1) *Physical Science, Elementary Teachers;* (2) *Natural Science, Elementary Teachers;* (3) *Aviation-Space Flight, Elementary-Secondary Teachers;* (4) *Conservation;* (5) *Science Concepts for Elementary Grades.*

CONNECTICUT

WESLEYAN UNIVERSITY, Middletown. Joseph S. Daltry, Director of the Summer Session. A course in *Basic Concepts and Processes of Mathematics* designed partly to help mathematics teachers clarify and enrich their own courses (specific teaching devices are suggested), also courses designed to bring teachers up to date concerning recent developments in general biology, genetics, general chemistry, physical chemistry, electronics, theory of equations.

FLORIDA

UNIVERSITY OF FLORIDA, Gainesville. N. Eldred Bingham, Professor of Education, College of Education. Doctoral program includes opportunities to specialize in teaching biological or physical sciences; elementary or secondary school science; or science education at the college level. Many science courses available throughout the University. Education program includes seminar and science education research. Summer offering: EdS 660—*Teaching Science in the Secondary School.* 3 credits. Current problems in teaching science in the secondary school. EDE. 560—*Teaching Science in the Elementary School.* 3 credits. Content, methods, materials in teaching science in the elementary school. EDE. 660—*Science Education in the Elementary School.* 3 credits. Current problems in teaching science in the elementary schools.

GEORGIA

ATLANTA UNIVERSITY, Atlanta. Edward K. Weaver, Professor of Education, School of Education. Courses in elementary and secondary science education, philosophy of science education, and laboratory experiences in problems of individual interest and need. Summer of 1954: *Workshop in School Health Education;* limited to 30 participants; open to school health nurses and teachers only.

EMORY UNIVERSITY, Emory University. John I. Goodlad, Director, Division of Teacher Education. This summer, a three and one-half week workshop in

science education, June 9 to July 2. Five quarter hours of graduate credit; $48.00 plus a $5.00 matriculation fee. Participants must have undergraduate background in science and must be teaching in secondary schools. Directed by Dr. Philip G. Johnson of Cornell University; Emory University science staff members will participate. Reservations required by May 15.

ILLINOIS

BRADLEY UNIVERSITY, Peoria. Leo G. Bent, Dean, College of Education. *Recent Developments in Physics and Chemistry;* a two-semester hour course for teachers of science. Summer of 1954: *Guidance Workshop* (2 weeks); *School Administrators and Public Relations* (1-week workshop); *Administrator-School Board Relations* (1-week workshop).

INDIANA

PURDUE UNIVERSITY, Lafayette. Dan H. Cooper, Director of Education. A field course in conservation of natural resources offered at Versailles State Park (two semesters—3 hrs. each); undergraduate and graduate credit available. Curriculum and methods courses in biology, chemistry, physics, and physical education and health; undergraduate and graduate credit available.

IOWA

IOWA STATE TEACHERS COLLEGE, Cedar Falls. C. W. Lantz, Head, Department of Science. Iowa State Teachers College Summer School—June 10 to August 18. Studies leading to the degree of master of arts in Education. Student may specialize in science in his field of particular interest, either in elementary or secondary teaching. 1954 summer: *Iowa Teachers Conservation Camp*—outdoor experiences in conservation and nature study. Three 3-week sessions, beginning June 6. Undergraduate and graduate credit.

MAINE

UNIVERSITY OF MAINE, Orono. Mark R. Shibles, Dean, School of Education. In the M. Ed. program approximately half the work may be taken in carious fields of science. All professional study may be related to science education. No thesis is required. In the summer of 1954: broad offering of courses and seminars in the natural sciences and science education involving laboratory and field studies.

MARYLAND

MORGAN STATE COLLEGE, Baltimore. Thomas P. Fraser, Head of Department of Science Education. The 1954 workshop course is designed to promote understanding of the contribution of community resources to the development of science teaching programs in the elementary and secondary schools. Consultants include representatives of the U. S. Office of Education, Atomic Energy Commission, State and City Departments of Education, and the resident staff of Morgan State College.

MASSACHUSETTS

BOSTON UNIVERSITY, Boston. Professor Sherborn, Director, Summer Session. Boston University offers graduate work in science education with M.A., M. Ed., Certificate of Advanced Graduate Specialization, and Ed. D. Student teaching for those without experience in regular session. 1954 summer courses: *Teaching Science in the Secondary School; Science in the Elementary School, Materials and Methods.*

HARVARD GRADUATE SCHOOL OF EDUCATION. Fletcher G. Watson, Associate Professor of Education, Lawrence Hall, Cambridge 38, Mass. Master's degree attainable through part-time or summer study. Master's and doctorate study in Science Education and (with School of Public Health) in Health Education. Cooperation of University faculties provides broad study program. This summer: *Current Developments in Science;* 8 units; Professor Eugene G. Rochow (Chemistry). Applications to teaching stressed. For fellowships, apply by May 1.

MICHIGAN

WAYNE UNIVERSITY, Detroit 1. Florence G. Billig, Professor of Science Education, College of Education. Wayne offers master's degree in Education with a specialization in teaching science on elementary and secondary school levels. Prerequisite is adequate background in science; minimum of 12 hrs. of graduate work in specialized field. Professional courses: *Physical Science—Elementary Schools; Materials and Methods of Teaching Science in Secondary Schools;* seminar and essay direction. Also, science courses on graduate level offered by College of Liberal Arts.

MINNESOTA

STATE TEACHERS COLLEGE, St. Cloud. W. C. Croxton, Chairman, Division of Mathematics and Science. First summer session: June 7 to July 16; offers *Graduate Workshop for Science Teachers; Graduate Course for Elementary Teachers* in planning and implementing a functional science program. Second summer session: July 17 to August 20; offers *Workshop in Conservation Education* for advanced undergraduates and graduates. Operated jointly by Departments of Science and Social Studies. Minnesota is delightful in the summer!

MISSOURI

ST. LOUIS UNIVERSITY, St. Louis. Theodore A. Ashford, Professor of Chemistry and Director of Summer Institute for Chemistry. A specially designed program for a master's degree in the teaching of chemistry. A balance of advanced work in chemistry supporting work in physics and mathematics and in education. 1954 summer program offers *Seminar in the Teaching of Chemistry*—teaching problems; lectures by nationally known lecturers, and visits to industrial and scientific research laboratories. Review course in elementary chemistry. Lecture-demonstration course.

MONTANA

MONTANA STATE COLLEGE, Bozeman. Milford Franks, Director of Summer Quarter. MSC offerings are in all fields of science emphasizing education for teachers at the graduate level through Master's degrees with thesis and without thesis planned over broad biological and physical science areas. 1954 summer offering (in an outstanding place for summer recreation and study): A graduate course, *Seminar in Science Teaching,* offered June 14-July 16 for presentation of basic problems and new materials.

NEW JERSEY

RUTGERS UNIVERSITY, New Brunswick. Charles H. Stevens, Director of the Summer Session. Announcing the *First Annual Science Institute* conducted jointly by the University and the New Jersey Science Teachers Association, July 7 to 16, to examine elementary and secondary school practices. Institute will live and work together on campus. Two credits. Other offerings: *Workshop in Geography,* July 6 to 17, 2 credits; *Principles of Biology for Teachers,* June 28 to August 6; *Methods and Organization in the Teaching of Biological Science in the Secondary School,* June 28 to August 6.

NEW YORK

CORNELL UNIVERSITY, Ithaca. Philip G. Johnson, Chairman, Nature, Science and Conservation Education. Graduate program following no rigid pattern is planned by student and the committee he selects. Science, methods of teaching, and acquaintance with some scientific research are emphasized. Use of local community resources is stressed. Summer of 1954 offers: a three-week *Workshop in Secondary School Science* and one in *Conservation Education;* also, *Elementary School Science, Audio-Visual Aids, Field Natural History,* and *Biological Techniques.* (See *The Science Teacher,* Feb., 1954, p. 32.)

SCHOOL OF EDUCATION, NEW YORK UNIVERSITY, New York City 3. J. Darrell Barnard, Chairman of the Department of Science Education. The summer program has been designed to provide meaningful experiences for both elementary and secondary school teachers in re-evaluating, re-designing, and re-tooling their curricula to meet the challenge of modern thinking regarding the way in which young people learn. Workshops in elementary science and conservation education and special field courses related to science in action highlight the summer offerings.

STATE UNIVERSITY OF NEW YORK, COLLEGE FOR TEACHERS AT BUFFALO. John Urban, Chairman, Science Department, 1300 Elmwood Avenue, Buffalo 22. *Summer Science Camp,* Aug. 8-20, for elementary, junior high school teachers; all field work; non-technical; emphasis on helping classroom teacher; study of plants, animals, earth science, etc. In beautiful, mountainous Allegany State Park; cool, delightful weather; graduate, undergraduate credit, or non-credit; total cost, about $75.00.

STATE UNIVERSITY TEACHERS COLLEGE, Potsdam. William G. Hamilton, Chairman, Science Department. Through this summer's workshop, *Science 506—The Teaching of Science in the Elementary School,* teachers will become familiar with resource materials as course outlines, texts and supplementary reading materials, science handbooks, films, free science materials from industrial concerns. Various methods of teaching science will be considered; also ways of evaluating the outcomes and contributions of science instruction. July 19-30; 2 semester hours; directed by Mr. Nelson Beeler, a member of the College science department; he serves as a science consultant in Campus School and is the author of a series of books presenting science experiences and experiments for use in the elementary school.

SYRACUSE UNIVERSITY, Syracuse. Alfred T. Collette, Dual Professor of Science and Education. Syracuse University offers three graduate programs leading to the doctorate: Ph. D. (Science Education); Ed. D. (Science Education); and Ph. D. (College Teaching Program). In addition, the M. S. in Science Education is offered and an M. S. in General Science. The programs are flexible enough to meet the needs of individuals concerned. Offerings the summer of 1954: *Geology 120—Workshop in Earth Science for Teachers; Elementary Science Education 136—Methods and Materials in Teaching Elementary Science; General Science I—Science for the Elementary School Teacher;* and *Science Education 275—Workshop in Science Education.*

TEACHERS COLLEGE, COLUMBIA UNIVERSITY, New York City 27. Miss Marie Stoll, Secretary, Science Department. A summer session offering of general and specific methods courses and science education research, supplemented by many subject matter courses in Teachers College and other Colleges of the University. A June course in science field work and conservation for elementary and secondary school teachers, centered at Gettysburg College, Gettysburg, Pennsylvania.

OHIO

MIAMI UNIVERSITY, Oxford. C. H. Robinson, Director of the Summer Session. The *Midwestern Aviation Education Workshop,* June 28-July 23, for elementary and secondary teachers. Carries four hours graduate or undergraduate credit. Non-technical approach to aviation subjects; optional flight experience, demonstrations, field trips. *Workshop in School-Community Health Problems,* July 5-23; 3 credits. *Field Laboratory in Conservation Education,* June 21-July 23.

OHIO STATE UNIVERSITY, Columbus. John S. Richardson, Professor of Education. Graduate degree programs highly adjustable to student backgrounds, specific needs, and next-step aims. 1954 summer offerings include: *Teaching of General and Physical Science; Laboratory Practicum for Science Teachers; Science Education in Higher Education; Seminar in Science Education.* All courses carry graduate credit.

OREGON

OREGON STATE COLLEGE, Corvallis. Stanley E. Williamson, Science Education Department; or, Henry P. Hansen, Dean of Graduate School. A summer program in graduate science leading to a Master's degree with a major in general science and with a minor in education, science education, or some other field. Different courses in the biological and physical sciences especially designed for science teachers are offered in a three-year rotational program. Thesis optional for the Master's degree in general science. 1954 summer courses designed for teachers: *Morphology and Evolution of Higher Plants; Laboratory Aids in Biology; Invertebrate Zoology; Collection and Preservation of Zoological Materials; Advanced Modern Physics; Geological History of Life; Rocks and Minerals; Mathematics for High School Teachers.*

RHODE ISLAND

UNIVERSITY OF RHODE ISLAND, Kingston. Frank M. Pelton, Acting Director, Summer School. *Workshop in Natural History.* Field, classroom study of living world. Teachers, camp counselors, and beginners in conservation. June 29-August 7.

SOUTH CAROLINA

CLEMSON COLLEGE, Clemson. J. B. Gentry, Professor, School of Education. Strong science departments—Botany, Bacteriology, Entomology, Zoology, Chemistry, Physics—for basic subject matter; Agricultural and Engineering Experiment Stations for research. This summer: *Teaching of Science in Elementary Schools,* a three-weeks course July 26-August 14 by Miss C. Skelton; *Technique of Teaching in High School,* June 14-August 14, by J. L. Brock; *Health Education,* June 14-August 14, by J. B. Gentry; *Conservation,* May 14-June 12, by F. E. Kirkley.

TEXAS

NORTH TEXAS STATE COLLEGE, Denton. Robert C. Sherman, Professor of Biology and Chemistry. Graduate program in the science division. Special science subject matter courses for teachers plus science methods courses. Unusual field experiences available. Major possible either in education or in science. Next summer we offer field travel course in conservation of Texas and regional resources. Also, field course in limnology and water sanitation adapted for teachers.

VERMONT

NORWICH UNIVERSITY, Northfield. Philip S. Hopkins, Head, Department of Aviation. Norwich University will conduct an *Aviation Education Workshop for Teachers,* July 1-August 12; six credits. Valuable teaching aids and wonderful vacation opportunities.

UNIVERSITY OF VERMONT, Burlington. L. S. Rowell, Director, Summer Session. *Conservation;* graduate credit, six semester hours; lectures and field trips with over thirty visiting specialists in conservation practices, including animal, plant, soil, water, and mineral resources. Also offered this summer: *Science Methods for Elementary Teachers,* demonstration school; *Science for Teachers,* content course for elementary and junior high levels.

VIRGINIA

UNIVERSITY OF RICHMOND, Richmond. Edward F. Overton, Chairman, Department of Education. Offering *Education S449—Functional Science Teaching.* The place of science in the elementary and the junior high school; using science in promoting learnings in other areas; resourcefulness in utilizing readily available materials; preparation and preservation of materials.

Teachers interested in summer jobs with the Forest Service should secure Civil Service application form 57 or 60 from a Post Office or office of the Civil Service Commission, and send it to the Regional Forester of the Region in which he is interested in employment. The Forest Service employs a considerable number of seasonal workers on the National Forests during the summer vacation period. Preference is given to local experienced people dependent on seasonal employment and to students enrolled in forestry schools. However, there are usually a considerable number of jobs available for other applicants and the Forest Service has been placing teachers in these positions for several years.

FIRST WEEK OF SCHOOL—

continued from page 120

say that the sanding disc came up for review as a competitive product. We first discuss how the teams of scientists and engineers could examine the product, then make a guess as to how such a product could be made. We try to imagine how these men would think as they endeavored to make a better product. As we discuss this, we would have samples to handle and examine just as the engineers might. Next, we would try to find out what tests such a product might be put through. We would discuss testing as it is done in a laboratory and as it might be done in the field. From the findings would come a new or an improved product. This method of presentation seems to be fairly effective, especially when we can show the students that just such a method is used by industry even to the new products that come out of such thinking.

We follow through in this line of thought in the laboratory. For the most part, we have eliminated the opening exercises such as identifying the pieces of apparatus, bending glass, and dismantling a Bunsen burner. Instead, we suggest experiments that might be used to illustrate an idea or prove a point and then encourage the students to state honestly what they did and what they observed. At this stage of operations, we feel that it is important that the student draw conclusions from his own observations. Careful observations and honest reporting and recording of them is one thing that science demands.

While this is a concentrated program that must be carried along with the getting acquainted with the students, it sets the tone for the entire year. I find that this system is quite successful and satisfying to me also.

IRENE HOLLENBECK, biology teacher in the Salem, Oregon, Senior High School, has published several articles based on her tried-and-tested classroom techniques (*The American Biology Teacher, May, 1945; Selected Science Teaching Ideas*, NSTA; and *Selected Teaching Procedures in Teaching Biology*, Oregon State College Press). Here is a sample of how she does it.

Exploring is the keynote of our first weeks of biology. The first day the room is set up like a science fair with *problem-solving* types of experiments on the tables, student-made posters on walls and bulletin boards, exhibits of projects completed by last year's students, an electric game board, a "What Is It?" shelf, a "Believe It Or Not" table (i.e., a tomato is a fruit), cages of live animals, and a bookcase full of interest-challenging books *(Magic in a Bottle)*. In opposite corners of the room former students are ready to project color slides taken on field trips last year, and to show slides of pond water, blood, etc. under the compound microscope. Students are invited to spend the hour exploring the room to find out what they can about biology.

The next day is spent discussing discoveries made and getting acquainted with each other. Students are told they must know the complete names of 30 animals and something interesting about each by the end of the week. Frowns change to smiles when they learn this assignment refers to the 30 *Homo sapiens* in the room at the time.

Field trips occupy our attention the rest of the week. To find the answer to the question: "Why are there few trout in Mill Stream in Salem?" we visit this stream which cuts across our campus and committees check the flow, temperature, depth, and turbidity of the stream, and the animal and plant life in the water and nearby. Interested boys make similar checks on streams where trout are caught and we are on our way toward an attempt to answer our question.

Another type of field trip we often use the first week is the "self-guided" tour of the campus. For this I give the students a list of things to look for and to do at a number of specific places on the grounds (find the animal inside the gall on the oak leaf, watch the children at play in the park, etc.). Biological scavenger hunts are other good first week field trips which start students *observing*.

Next we spend a few days exploring with a microscope. What better introduction to its use than a drop of pond water full of *active* protozoa? With no drawings to make or reports to give we can have fun hunting for plants and animals. As on the field trips and room explorations, interest is aroused, questions arise.

These early experiences lead us to exploring in the library to find books and magazine articles on subjects in which we have become interested.

Thus during the first two weeks, without the use of textbooks or lectures, we bring to the attention of the students as many different aspects of biology as possible. The students are then ready to choose the units to be studied during the year, to volunteer for committees, and to start planning the first unit. We are all well acquainted, we have developed a curiosity about a number of things, and we know something of the tools we will use in discovering more about this interesting world in which we live.

In describing "a metropolitan approach," MAITLAND P. SIMMONS, teacher of general science in the Irvington, New Jersey, High School, tells how he uses one of the 35 experiments described and illustrated in his book, *The Young Scientist*.

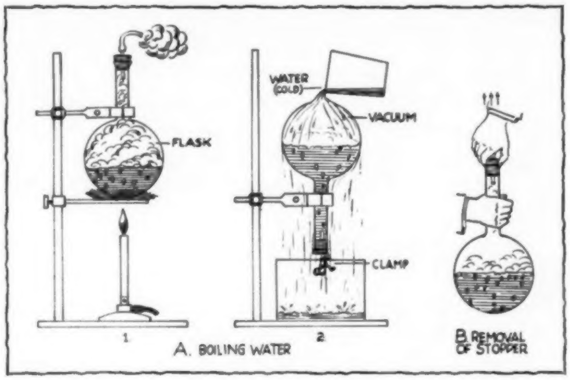
The chief difficulty in the beginning of the school year is to find sufficient time to get acquainted with your students. Since the opening of school brings with it an enormous amount of clerical and instructional detail, this opportunity is often lacking unless efficiency prevails. On the first day back to school, students fill out a 3 x 5-inch pupil-information card. Such data include name, age, address, science interests, hobbies, extra-curricula activities, and employment of parents. After school dismissal, a more complete picture of the child is obtained from office records; namely, citizenship, discipline, scholarship, I.Q., and audio-vision defects. That evening, and the remainder of the week, considerable time is spent by the teacher in learning names and studying case-histories. With this all-important knowledge at hand, the teacher is better able to observe and recognize significant causes of pupil attitudes and behavior. The emotional factors involved become more significant and the teacher is better able to give each pupil an opportunity to achieve the highest possible degree of personal and social competency.

An orientation program follows with students participating. For the industrial-minded boy and girl, long-range projects concerning timely subjects are suggested and procedures explained. In the spring the better ones are displayed at some public exhibition or a science fair. For the more scholarly-minded student, lists of scientists' biographies and science fiction are posted on the bulletin board.

At this point the teacher is ready to explore the science-background of the class through life situations and past experiences. An outgrowth of this phase is the selection, classification, arrangement, and organization of basic subject matter content. A highly desirable beginning unit and relatively simple one to understand is Air. Important concepts in science are then presented and developed easily as this topic lends itself readily to the activity approach. The desirability of the subject is determined by asking carefully-planned questions:

1. What is air?
2. Does air exert pressure? Explain.
3. Would the ocean boil if the air were removed? Explain.

At this stage it seems likely that the last question could be solved effectively through a satisfying activity: Can we boil water by cooling it? The apparatus needed is set up and arranged systematically on the demonstration table, ready for pupil-teacher participation (see illustration). For effective results in this part of the work, students should be encouraged to make neat sketches, record data, and interpret their findings independently. Personal supervision is given wherever needed with the insistence of a high standard of accuracy, but, on the other hand, allowing for originality of expression. To sustain interest and promote competition, the better papers are posted the next day on the bulletin board.



COURTESY EXPOSITION PRESS, INC.

Boiling Water By Cooling It

Finally, the teacher summarizes the salient points of the organized experience from a set of follow-up questions which help young people relate the guided activity to other happenings they know about, stimulating their new knowledge in interpreting the phenomena of everyday life, and lastly to encourage them into further experiments.

MR. CALVIN GRASS, head of the science department in the Lancaster, New Hampshire, High School, doesn't exactly take his boys fishing the first week of school, but he does find it useful in launching his physics course to start with a good fishing stream.

Students never cease to be amazed to find that in studying physics they are simply explaining in an organized and logical way the world around them. If the class consists of boys interested in the out of doors, a simple question such as, "How was the fishing around here this year?", may be all that is needed to bring forth a burst of enthusiasm and interest in physics. Of course, we are interested merely in using this subject as a springboard into physics. It should take very few minutes to guide the class to thinking of one stream in particular. At this point begins the organizing of physical data. The stream—where does it come from? What

force is it that causes it to flow down hill? How strong is that force? Why is there the experience of fatigue when we follow a stream uphill? Why is the stream more rapid at some places than at others? What determines the depth of the water? Is there any difference in temperature at various places on the stream? What forces act to "cut" the river channel?

These are only a very few of the many questions which could be phrased by teacher and students. Other questions may deal with mechanical and electrical power. A field trip during the first week of school to observe phenomena related to the questions makes a good way to begin the lab part of the course. Let the students know they are dealing with reality. At the beginning of the eleventh or twelfth grade the students are not ready to deal with abstract concepts. During the year you can probably help them organize their thinking to include abstractions. We, as physics teachers, must remember we are teaching adolescent youth, and not operating electronic brain control panels.

After the questions have been presented it is up to the instructor to arrange them skillfully into an outline of the proposed course in physics. It is especially necessary here that the situation be that of teacher guidance and pupil participation. As this arranging progresses the students begin to see some of their own lives—not some remote collection of cold facts. The writer has used this type of approach to physics and found it successful. It does what it is meant to: that is, to put the student at ease so he can enjoy the study of physics.

Teaching general science in the Crestview Junior High School, Columbus, Ohio, is a never-ending thrill for CHARLES A. BEACHLER. You can sense the enthusiasm in his words as he tells how he launches 8B general science work.

"Jim, what do you think of when we say 'Science'?"

A busy few minutes have been used to get a roll, names individually written on prepared slips of paper, and collected alphabetically—hasty acquaintance, first meeting, no texts yet. But here's a couple dozen, or more, twelve (plus)-year olds—curious, hearty, and mostly wondering what can be interesting about 8B General Science.

Jim was not picked on as a doubter, and when he got a big smile with the question, he was ready. You don't need his answer here. It didn't matter, for there are always plenty of followers with their offerings when they find that here's something they can talk about, have already heard about. Elementary? For sure, but that's our problem every new semester; new to them, interesting only if we can feel the newness with them, even after maybe scores of repetitions to us.

Then a follow-through: "Have any of you ever seen a science article in the newspaper?" Followed by: "Will each of you get a clipping this evening? Ask dad or mother tonight to help you find one." In Big Town or country, the merest attachment of home with the work of the school pays off, all the time.

So the bulletin board gets a wealth of material. A first assignment has been easy. "This science is O.K." And when the new book comes the next day or so, it has interesting pictures. "Why are there no clouds much higher than the highest mountains? How high has a balloon gone up? Have airplanes gone any higher?" And we are wondering about the air; and before this first week is over, we are weighing it in a football, testing its capacity of occupying space with the inverted drinking glass pushed down into the dishpan at home.

This home assignment again is almost sure to get mother into it this time, the football is handled in the laboratory, but brought from home by a ready contributor. So we have done an "experiment," worked a problem, tested an idea, and "Can we make records of these procedures?" Even new words have an attraction to enough youngsters to merit attention, and many of this age like the challenge of spelling new words—all need the practice of putting sounds into letters. So, before this week is ended, there is likely to be a spelling lesson or a spelling match.

Would you dare say this has not been a busy week? Or would you doubt that it has been an interesting one for the beginners in science? Some couldn't spell the word; have now learned how and even added the bigger ones, 'scientist,' and 'scientific'.

HERBERT H. REICHARD, physics teacher in the Allentown, Pennsylvania, High School, is already planning on how he will start his students in physics next fall. For a peek into his future—and yours for the taking if you want to use his ideas, here is his contribution to this symposium.

Recognizing the popular interest in atomic energy, I shall start my physics classes next fall with a survey of atomic energy. To correlate with chemistry previously studied, I shall use the Life film strip on "The Atom." I also plan to use the sound film, "A Is for Atom," by the General Electric Co. Each student will receive a copy of *Adventures Inside The*

Atom (General Electric Co.) and *The World Within The Atom,* a Westinghouse Little Science Series booklet.

I shall demonstrate on the electrical nature of matter, using static, electrical, and electrochemical demonstrations. The history of atomic energy will be presented through the film strip on *The Atomic Bomb,* by Visual Sciences, and selected parts of "The Story of the Atom Bomb and the Hydrogen Bomb" as related by William Lawrence and Bob Hope in the documentary recordings, *The Quick And The Dead* by RCA-Victor.

In demonstrating I shall use apparatus made in past years by students: an atom board to show the structure of atoms and the differences among their isotopes; a Tesla coil, and a Van de Graaff generator. Students will be able to study the radioactivity of uranium ore and other sources of alpha and beta particles and gamma radiations by using a portable "Super Sniffer" and a "Class Master" Geiger Counter.

The use of student projects will lead naturally into arousing student interest in starting projects for the 9th Annual Lehigh Valley Science Fair, writing qualifying essays for the 14th annual Westinghouse Science Talent Search, and preparing entries for the 4th year's program of Student Science Achievement Awards conducted by the Future Scientists of America Foundation of NSTA. I shall have color slides of projects from the past two science fairs to use in motivating interest in student participation in all co-curricular science activities.

In conclusion I shall select from the film strips, *Making Atomic Energy Help Mankind* by the Popular Science Publishing Co. and *The Atom At Work* by SVE, to show peacetime uses of atomic energy. Time permitting I shall use the film slide, *You And The Atom Bomb,* by Visual Sciences.

Such an informal introduction to physics, covering probably two weeks time, emphasizing the dawn of a new era in the generation and control of energy should do much to interest the students in the more formal study of the fundamentals of physics.

MARGARET J. McKIBBEN, biology teacher in the Oak Park and River Forest High School, Oak Park, Illinois, uses the familiar, the interesting reading, and a biological adaptation of a TV "quiz program" as devices for easing into the course of instruction.

The traditional phylogenetic approach to high school biology has psychological merit in that it presents the "whole" plant or animal before introducing its "parts" (cells). However, such a beginning made through read-about-talk-about activities seldom stimulates interest—even in the academic minded. A "museum laboratory" is a type of first week activity which may remedy this.

The required materials are the usual school collection of jars of preserved plants and animals, shells, skeletons, herbarium collections, bird skins, and mounted mammals. An important addition, however, is as many live materials as possible. These may include bread molds, shelf fungi, mushrooms, mosses, lichens, pond scum, water fleas, earthworms, insects, salamanders, snakes, and a hamster. Boys and girls should be permitted to handle these materials freely. Representatives of less important phylums as well as specimens which are repulsive should be omitted.

Printed cards indicating the common names of the phylums (sponges, flatworms, spiny-skinned animals, etc.) rather than Latin ones are used. One side of the room is devoted to plants, the other to animals. Arrangement of the tables of specimens indicates progress from simple to complex forms.

A follow-up activity may be the leafing-through (not careful reading) of such plentifully illustrated textbooks as Buchsbaum's *Animals Without Backbones,* Hegner's *Parade of the Kingdom,* or certain of the Row, Peterson booklets as *Insect Friends and Enemies, The Plant World,* and *Adaptation to Environment.* This may be accompanied by such exploratory questions as "What did you learn about bats today that you didn't know before?" or "What was the most interesting insect you read about today"?

A second follow-up activity found to be profitable and interesting is a game called "What's My Phylum"? The rules, deducible from a popular television program, may be adapted to suit the situation. A pupil tells the teacher the name of a plant or animal he has chosen. Members of the class are to guess the name of the phylum to which the organism selected belongs by asking such questions as "Do you have a backbone?", "Do you have a shell?", etc. The teacher's role is to help the pupil who is "It" answer the questions correctly.

It soon becomes apparent that the first question to ask is "Do you belong to the plant or the animal kingdom?", followed by "Do you have chlorophyll?" or "Do you have a backbone"? An understanding of the principles of classification is gained as pupils learn a pattern of questioning leading them to the right answers.

This symposium will be continued and concluded in the September 1954 issue.

Bayles—continued from page 116

are practically out of the question for most high-school and even college laboratories. Only the simplest, or incomplete parts, of such experiments can be performed during the time and with the facilities available. What should be done? Perhaps, in the context of a larger question under study, it would be well to perform such experiments, or parts of experiments, as can be performed, then to read about how the whole experiment was done under ideal conditions. The actual performance of what can be done in a school laboratory, if in the context of a larger problem, will give students certain first-hand experience which will help them achieve the insights necessary to read, with intelligence and wisdom, the reports of what others have done. Under such circumstances, it will be quite unnecessary to apologize to anyone insistent on scientific procedure for substituting such readings for mere time spent in laboratory puttering. In terms of improved student attitudes, the results would perhaps be astounding.

In this connection we would recommend perusal of Conant's proposals, in the previously mentioned book, of an over-all study plan. Our only significant point of disagreement is his remark that the plan is suitable only for general education, presumably on the junior-college level. The plan would seem to be highly advisable for advanced classes as well.

Closely allied to the concept of science as an inductive process is the tendency to hold hypotheses in low esteem. We have noted previously Newton's comment that "hypotheses . . . have no place in experimental philosophy." In an article from an issue of SCIENCE EDUCATION appearing in late 1950, we find the statement that

> Proper science instruction will help individuals to understand that natural laws, principles, and fundamental scientific theories have rather high worth, while hypotheses, superstitions, hunches, guesses, and deliberate lies are inferior ideas.

It is not often that a responsible writer publishes a statement which places hypotheses in the same category as superstitions and deliberate lies. But to publish statements which *imply* inferior status of hypotheses—inferior to established principles or laws—is not uncommon. Such statements imply that guesses or hypotheses are what one indulges in before achieving "real" knowledge, but are to be discarded as soon as a "law" is discovered. This attitude is a logical consequence of the belief that science is a strictly inductive process. When the present writer studied chemistry in college, there was considerable controversy as to whether it should be called Avogadro's *Law* or Avogadro's ***Hypothesis.*** The "status" of the principle would presumably have been greatly enhanced if it could without question have been called a law.

As a result of the Einstein revolution in physics, however, scientists who understand its implications no longer look down their noses at hypotheses. On the contrary, they recognize scientific generalizations of any kind as never getting beyond the realm of the hypothetical. They say, in effect, that the claim is not that atoms and molecules "really are" the way they are now envisioned. The claim is merely that they "act as if they were" that way. And they do not entertain any particular hope that it ever will be otherwise. That is the meaning of the Walsh statement, quoted earlier, regarding analogies and parables.

Relativistically speaking, the world's wisdom is taken to be couched in the form of hypotheses, free inventions of human minds; hypotheses in which greater or lesser degrees of assurance can be placed, dependent upon their degree of verification by human experience particularly in the form of scientific experimentation. Therefore, rather than placing hypotheses in the category of "inferior ideas," the attitude of competent men of science today is that hypotheses should be accorded all of the respect due to scientific generalizations of any and all kinds, because scientific generalizations never divest themselves of hypothetical status.

This article is addressed primarily to science teachers, to those responsible for courses in the teaching of science, and to those interested in working out a philosophy of science. For it seems that among such groups there is widespread failure to grasp the significance, for their fields of concern, of twentieth-century changes in the form of scientific investigations as well as in theories regarding it. To view scientific procedure as strictly inductive means failure to portray wth accuracy the process of scientific investigation as it is carried on today. Such failure causes the teaching of science to fall far short of achieving the educational values which might otherwise be achieved.

If we wish to continue using the words induction and deduction, we should recognize clearly the inductive-deductive nature of scientific method, what of it is inductive and what is deductive, and strive to achieve due recognition of the proper place and function of each. Science education stands much in need of the benefits which will accrue from such clarification.

NSTA Activities

Workshop on Community Science Resources

This five-day workshop, planned especially for the NSTA summer conference, will meet Monday, June 28 through Friday, July 2, at New Paltz, New York, State Teachers College. It will provide an opportunity for participants to examine the inter-relationships of scientific, social, and physical problems in American communities. Through a series of field trips, participants will evaluate community resources and techniques for dealing with them through the classroom. Included in the field trips will be the following:

1. A day in New York City attending the meeting of the National Science Teachers Association.
2. A trip to a scientific orchard or a trip to a large chick hatchery.
3. A trip to a major industry in the area or a trip to a government science center.

The hours for the program each day will be determined by the group, but they will probably extend from nine in the morning until three in the afternoon. Fees for this non-credit workshop are $10.00. In addition, minimum transportation fees will be arranged for the field trips. For information, write to Dr. Harold Tannenbaum.

Board of Directors, 1954–55

As announced at the Chicago convention by Richard H. Lape, chairman of the nominating committee, the mail ballot for election of officers and directors produced the following results.

For *President-Elect, 1954-55,* Robert Stollberg, San Francisco, California; for *Secretary, 1954-55,* Dorothy Tryon, Detroit, Michigan; for *Treasurer, 1954-55,* John S. Richardson, Columbus, Ohio (re-elected for second term). These officers, together with *President* Walter S. Lapp, Philadelphia, Pennsylvania, *Retiring President* Charlotte L. Grant, Oak Park, Illinois, and *Executive Secretary* Robert H. Carleton, Washington, D. C., will comprise the Association's Executive Committee.

Newly-elected members of the Board of Directors include: *Alternate Director, Region I,* Ralph E. Keirstead, Hartford, Connecticut; *Director, Region II,* Charles G. Gardner, Syracuse, New York; *Alternate Director, Region II,* G. Marian Young, New York City; *Director, Region IV,* Ruth Armstrong, Fort Smith, Arkansas; *Alternate Director, Region IV,* Otis W. Allen, Greenwood, Mississippi; *Director, Region VI,* J. Donald Henderson, Grand Forks, North Dakota; *Alternate Director, Region VI,* M. M. Hasse, Aberdeen, South Dakota.

The terms of office of these new officers and directors begin with the close of the annual business meeting of the Board of Directors which will be held in New York City, June 26-27. Hold-over members of the present Board are as follows: *Regional Vice-Presidents,* Elra M. Palmer, Baltimore, Maryland, and Stanley E. Williamson, Corvallis, Oregon; and *Directors* Helen E. Hale, Towson, Maryland, John G. Read, Boston, Massachusetts, H. M. Louderback, Spokane, Washington, Blanche Bobbitt, Los Angeles, California, Glenn O. Blough, Washington, D. C., William F. Goins, Nashville, Tennessee, and Wayne Taylor, Denton, Texas.

Members who are retiring from the Board of Directors after one or more terms of service include Harold E. Wise, Lincoln, Nebraska; Zachariah Subarsky, New York City; Dean Stroud, Des Moines, Iowa; Greta Oppe, Galveston, Texas; John E. Habat, Jr., Euclid, Ohio; Mrs. M. Gordon Brown, Atlanta, Georgia; and Hubert M. Evans, New York City.

New York City Conference

The 1954 annual summer conference of NSTA will be held June 28 at Teachers College, Columbia University, in New York City. As is customary, this meeting is held in conjunction with the annual summer convention of the National Education Association.

The program which has been arranged under the chairmanship of Hubert M. Evans (NSTA Board member and Associate Professor at TC) is as follows.

THEME: MAN'S RIGHT TO KNOWLEDGE AND THE FREE USE THEREOF

(COLUMBIA'S 200TH ANNIVERSARY THEME)

9:00— 9:30	**Registration.** Foyer, Horace Mann. (At entrance to Horace Mann Auditorium).
9:30—10:45	**General Session.** Presiding, Charlotte L. Grant, President of NSTA.
WELCOME	Frederick Fitzpatrick, Head, Department of Teaching of Science, Teachers College, Columbia University.
ADDRESS	"Secrecy, Science, and Security"; Henry M. Foley, Associate Professor of Physics, Columbia University.

11:00— 1:45 Meeting of Discussion Groups and Luncheon. (Each group will go to luncheon any time between 12:00 noon and 1:30 P. M.)

Group I Science and the study of community problems.

Freedom for the elementary or secondary teacher of science to work with his students in his community on community problems. How can he be helped to make use of the freedom he has and to enlarge his sphere of community activity?

Discussion Leader: Harold Tannenbaum, Professor of Education, State University of New York, State Teachers College at New Paltz.

Consultants:

Maurice Ames, Principal, William W. Niles Junior High School, New York

Rufus D. Reed, Chairman Science Department, New Jersey State Teachers College at Montclair

Bernard Toan, Millburn Township High School, Millburn, New Jersey

Group II The free choice of subject matter.

Freedom for the elementary or secondary teacher of science to choose subject matter which he believes to be most appropriate for his students. How can the teacher of science work to constantly enlarge the range of choice in the selection of science content?

Discussion Leader: Ned Bryan, Assistant Professor of Education, Rutgers University, New Brunswick, New Jersey.

Consultants:

Irwin Gawley, Tenafly High School, Tenafly, New Jersey

Elizabeth Sharp, Science Co-ordinator, Board of Education, New York City

Howard B. Trombley, Caldwell High School, Caldwell, New Jersey

Walter H. Wolff, Principal, William Cullen Bryant High School, New York City

Group III Controversial issues in science education.

Freedom for the elementary or secondary school teacher of science to deal with and inquire into matters which are or may be controversial in the community. How can the teacher of science work to develop freedom of inquiry appropriate to or necessary for the

proper consideration of controversial issues of importance in science education.

Discussion Leader: Earl Goudey, Bronxville Schools, Bronxville, New York

Consultants:

Hugh Allen, New Jersey State Teachers College at Montclair

Martin Robertson, Executive Editor, The Macmillan Co., New York City

Zachariah Subarsky, High School of Science, New York City

Group IV Experimentation in science teaching.

Freedom for the teacher of elementary or secondary school science to experiment in their teaching. How can the elementary and secondary school teacher of science develop the skills and insights needed in order to do experimental teaching and to enlarge the scope of his freedom to experiment?

Discussion Leader: Robert Wickware, Professor of Education, Willimantic State Teachers College, Willimantic, Connecticut

Consultants:

Alfred Beck, Board of Education, New York City

William D. Fritz, Highland Park High School, Highland Park, New Jersey

Jerome Metzner, High School of Science, New York City

Helen Warrin, Principal, South 8th Street School, Newark, New Jersey

Group V The science student's right to knowledge.

The right of the elementary or secondary school pupil to knowledge; his freedom to participate in the selection of science content and activities. How can the teacher of elementary or secondary school science work to enlarge and give meaning to the right of pupils to have access to knowledge pertinent to their concerns, needs, and interests?

Discussion Leader: Burnett Cross, Educational Consultant, Hartsdale, New York

Consultants:

Mary Bilheimer, Teachers College, Columbia University, New York City

Brenda Lansdown, Department of Education, Brooklyn College, New York City

Mary E. Lutz, New Brunswick High School, New Brunswick, New Jersey

Group VI The science teacher and scientific research.

The responsibility of the elementary or secondary school teacher of science to support and to participate in the maintenance of scientific work in our society; to promote and advance the scientific way of thinking and working in the solution of educational and community problems.

Discussion Leader: Frederick Fitzpatrick, Head of Department of Teaching of Science, Teachers College, Columbia University, New York City

Consultants:

Theodore Benjamin, DeWitt Clinton High School, New York City

Thomas Blisard, Professor of Physics, Newark College of Engineering, Newark, New Jersey

Fred T. Pregger, West Orange High School, West Orange, New Jersey

2:00— 3:15 General Session. Horace Mann Auditorium. Presiding, Hubert Evans, Teachers College, Columbia University, New York City

Panel Discussion: "What is the significance of the theme, 'Man's Right to Knowledge and the Free Use Thereof,' for teachers of science?"

Samuel R. Powers, Professor Emeritus, Teachers College, Columbia University, New York City, *Moderator*

Paul Brandwein, Forest Hills High School, New York City

Nathan Neal, McGraw-Hill Book Co., New York City

Nathan Washton, Department of Education, Queens College, New York City

Robert Wickware, Willimantic State Teachers College, Willimantic, Connecticut

3:30— 5:00 Discussion Groups: (continued)

6:15— 9:00 Buffet Dinner, Teachers College Cafeteria.

Presiding, Walter Lapp, President-Elect of NSTA.

Address: "Soviet Science Today: Some Lessons for American Educators."

George S. Counts, Professor of Education, Teachers College, Columbia University, New York City

FSA Activities

FSA Chart Making Contest

This activity went over remarkably well, especially if we consider the exploratory element that is involved in any new enterprise. Forty charts selected from some five hundred entries were displayed for final judging at the Chicago Convention. The September issue of *TST* will carry the full story. The awarding of the prizes is scheduled for shortly after the opening of the 1954-55 school year. The winners are: first place—Dian Smoyer, Parkland High School, Allentown, Pennsylvania; second place—Norma Cipriano, Notre Dame High School, Maylan, Pennsylvania; third place (tie)—August Schug, Central Catholic High School, Toledo, Ohio and Elizabeth Walton, Salem Senior High School, Salem, Oregon. Honorable Mentions—Larry Lewis, Northwestern High School, Hyattsville, Maryland; Barbara Wiessler, Parkland High School, Allentown, Pennsylvania; June Macurdy, The Senior High School, Watertown, Massachusetts; Jean McCubbin, Presidio Junior High School, San Francisco, California; Robert Calvetti, Marquette High School, Ottawa, Illinois; Martina M. Basilio, Nazareth Academy, Rochester, New York; Judy Williams, Notre Dame High School, Maylan, Pennsylvania; George Coad, Acaalanes Union High School, Lafayette, California; Bob Armsby, Woodrow Wilson High School, Washington, D. C.; and Marjorie Blyth, The Senior High School, Watertown, Massachusetts.

Science Teacher Recognition Awards

Everyone shared the pride and glory associated with Dr. Eisenman's presentation of the awards to the winning teachers at the Banquet session of the Chicago Convention. Miss Helen Hale, Chairman of this year's Operating Committee, will present a complete report in the September issue. The winners are: $400 award—Edward Victor, Rogers High School, Newport, Rhode Island; $300 award—Maurice Bleifeld, Newton High School, Elmhurst, New York; $200 award—Phyllis B. Busch, Abraham Lincoln High School, Brooklyn, New York; and $100 award—Stanley C. Pearson, Pasadena City Schools, Pasadena, California.

Due to the high quality of this year's entries, the judges identified ten more teachers to receive special recognition. Carmelita Barquist, Salem High School, Salem, Oregon; Harriet S. Brockenbrough, Hermitage High School, Richmond, Virginia; Brother J. George, De La Salle Institute, Chicago, Illinois; Jeanne Gelber and Edith Hodges, Robert E. Lee Senior High School, Baytown, Texas; Philip Goldstein, Abraham Lincoln High School, Brooklyn, New York; Flora Kahme, Elementary School, Port Jefferson, New York; Ray Miller, Hunter College High School, New York City; Robert Molkenbur, Central High School, St. Paul, Minnesota; Col. J. Edgar Morris, Brown Community High School, Atlanta, Georgia; and Clifford Nelson, John W. Weeks Junior High School, Newton, Massachusetts.

Science Student Achievement Awards

Our goal for 1954 is at least two outstanding entries from each school in which there is an NSTA member. Remember—entries must be mailed to regional chairmen before May 15.

West Coast Conference

Aug. 13-27

This conference is teeming with more exploratory issues than any other single item in the Foundation's program. Are fellowships for summer conferences a good way for industry to supplement science teachers' salaries? Can a group of selected teachers work toward the solution of a professional problem and, at the same time, gain self-improvement? Can the methods and organization of successful research laboratories provide clues for the improvement of school science laboratory activities? Can high school science teachers and public and industrial research people discuss common problems and share mutually desirable suggestions? Can thirty-two selected teachers produce a manuscript that is geared to the everyday problems of the nation's science teachers?

For this conference we are cooperating with Oregon State College and the Crown Zellerbach Foundation. It will be held at Corvallis on August 13-27. Thirty-two fellowships of $200 each are available.

The participants will form work and study groups in general science, biology, chemistry, and physics. Time will be divided between exchanging ideas and experiences in presenting effective laboratory work, and preparing manuscripts for new and improved exercises. A por-

tion of the program will be devoted to visits to university, government, and industrial research laboratories. These visits will allow the participating teachers to see the skills and abilities of successful scientists.

Selection of participants will be based on the applicant's ability to share in the development of stimulating and practical science experiments for junior and senior high school boys and girls. To insure adequate geographical distribution, eight teachers will be selected from each of the states of California, Oregon, and Washington; and eight from the states of Arizona, Idaho, Nevada, and Utah combined.

Applications will be accepted any time before June 1 from general science, biology, chemistry, or physics teachers in the above states.

Application forms may be obtained from the Future Scientists of America Foundation, National Science Teachers Association, 1201 Sixteenth Street, N. W., Washington 6, D. C.

We are looking forward to additional conferences in the East and Middle West in 1955.

Summer Work For Teachers

A brochure "Let's Help America's Science Teachers Find Science-Related Summer Jobs in Industry," has been mailed to several thousand executives in dozens of industries. Let us know if it creates an effect in your community.

Classroom Ideas

Physics

Latent Heat of Evaporation

By BREWSTER OWEN, Science Instructor
Institute of Education, Bakht er Ruda,
El Dueim, Sudan

"Dear Editor: You frequently ask for contributions to 'Classroom Ideas' in *The Science Teacher*. Here is one which I have found to be eminently successful with my students. We have to know something about latent heat of evaporation in order to understand how we keep cool and it is desired to gain this knowledge, in large measure, through experimentation. But in places where there is no electricity we may have to be content with finding the latent heat of condensation. The diagram and the following description will explain how we proceeded. I also point out some of the advantages of this easy method for finding *L*, the latent heat of condensation." (Signed)

Method

Arrange a boiler and a source of heat as shown in the drawing. Fix both on one stand. Make the water boil rapidly enough to get a good flow of steam. Put a vacuum flask on a kitchen type balance, and put 250 g. of water into it. Note what the balance reading is .... 575 g.

Note the temperature of the water in the vacuum flask .... 31° C.

Blow steam into the vacuum flask on the balance until the water boils. The needle of the balance then jumps about 30 g. Remove boiler promptly. Note balance reading .... 610 g.

Calculation

The steam which changed into water weighed .... $610 - 575$ g. $= 35$ g.

The water rose from 31° to boiling point .... $100° - 31° = 69°$

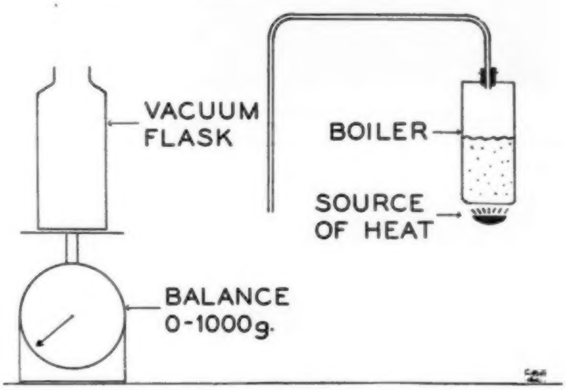
The heat gained by the water is .... 69×250 calories

This is equal to the amount of heat given out by the 35 g. of steam in changing to water. So the number of calories which one gram of steam gives out when it changes to water is

$$\frac{69 \times 250}{35} = 492 \text{ calories.}$$

This is the latent head of condensation of steam.

"The calculation is much simpler than in the usual experiment. There is no time wasted weighing on a chemical balance. Boys are interested in watching the pointer. The results are consistent: we obtained 492, 485, and 485 calories in consecutive experiments. Boys find it easy to suggest improvements in technique. There is scope for more advanced physics, cooling curves, thermometer errors, corrections for barometric pressure, and errors of the balance."



Biology

A Tree for Every Student

By ROBERT STANLEY, Biology Teacher
Perry High School, Perry, Ohio

The term "Conservation" has many ramifications and certainly covers a wide field of activities. One of our most successful conservation projects at Perry High School was associated with Arbor Day tree planting. This project had its inception in 1952 with Governor Frank J. Lausche's proclamation of April as Ohio Conservation Month. In this proclamation he set a goal of ten million trees to be planted in the state during the year.

I discussed this program with my biology classes and we decided to try to do our share to help reach the Governor's goal. A letter was drafted and mime-

ographed by the commercial department of our school inviting those persons in the community, who might be interested in such a project, to a meeting at the high school. Included were representatives of the Garden Club, the Boy Scouts, the Girl Scouts, the American Legion, Board of Education, school officials, local nurserymen, and other interested groups. At this meeting we discussed various projects that we might undertake which would benefit both the community and school.

Among the projects suggested and discussed was a school forest. This proposal has since been adopted and is now in its second year. To date about 5250 trees have been planted in this forest, and we are looking forward to its further development. However, the project adopted at the meeting, with which we are concerned in this article, is what we call our "Tree For Every Student" campaign. Through the generosity of the Champion Nurseries of Perry, Ohio, a white dogwood seedling was made available, free of charge, to each Perry student in grades one through twelve who would plant it in his own yard.

At our annual Arbor Day Assembly the plans for the program were explained to the junior high and high school students. In the lower grades each teacher explained the program to her own pupils. A letter explaining the program was sent home to the parents of each student. Instructions for the proper care and planting of the trees were included in the letter and were also discussed at the assembly mentioned above. At the close of school on a given day each student who had written permission from his parents was given a neatly balled dogwood tree. In all, about 700 trees were distributed.

Through this project we feel that the students together with the community received many benefits. The students learned how to plant and take care of a seedling; for each student, rather than just a few, had the responsibility of planting his own tree. Certainly they learned something of city planning and the desire to have a community attractive in appearance. Even if their seedling died they must have learned how precious a resource a tree actually is. Lastly, the community benefited in training good citizens for the future—and no one can deny the beauty of dogwoods blooming in the spring. To make this project a complete success it should be conducted for several successive years. We have not been able to do this, for we have devoted our time and interests to the school forest, but we hope to come back to our "Tree For Every Student" project and make our little village a better and more attractive one.

Book Reviews

A Brief Course in Semimicro Qualitative Analysis. William E. Caldwell and G. Brooks King. 163 pp. (paper bound). $2.10. The American Book Co., New York. 1953.

This is a concise text and laboratory manual for a one-semester course in qualitative analysis. Principles are discussed first, followed by a section on anion analysis, then cation analysis, general unknowns, and 121 questions. The appendix includes directions for making the necessary solutions.

Thirty of the questions are problems involving the Law of Mass Action. Calculations for *p*H and hydrolysis are not included although a table relating *p*H to the concentration of the hydrogen ion is given. There are sixty-nine questions on laboratory tests and separations. The reversal of the usual order of analysis seems logical for a second-semester course following a study of nonmetals the first semester. Tests for fifteen anions are given. The cation analysis is the traditional five group separation using H_2S, with Na_2S_2 being used for the subgroup separation of Group 2. The preliminary exercises are very concise and in many cases, particularly with the anions, are merely the running of a known solution.

The authors are to be commended for their willingness to use a simple approach where it contributes to teachability, in the discussion and applications of principles particularly. In some cases, however, the laboratory directions are too simplified. For example, in the tests for cadmium and aluminum other sulfides and silicic acid, respectively, often cause misinterpretations. Interferences in other tests are not mentioned in many cases, but even a much more detailed book can not cover all these possibilities. This merely points up the need for continual laboratory supervision and instruction. The clarity of directions, the diagram of procedures, and the excellent questions concerning the laboratory separations are commendable.

It is unfortunate that the pages are perforated. The reason for this feature is not apparent and the type of perforation used practically guarantees that pages will soon be lost from the manual if it suffers the usual treatment given qualitative manuals.

These minor derogatory points, and a very few cases where more accurate phraseology is possible, should not override the fact that this book should serve very well for a freshman course in qualitative analysis.

J. W. Neckers
Southern Illinois University
Carbondale, Illinois

Not Only for Ducks—The Story of Rain. Glenn O. Blough. Illustrated by Jeanne Bendick. 48 pp. $2.25. Whittlesey House. McGraw-Hill Book Company, Inc. New York. 1954.

Mr. Blough's latest book is designed to help youngsters understand the importance of rain. Any child reading it will also enjoy the lucid, simple style and the pleasant, easy narrative.

The author, specialist in Elementary Science in the Office of Education, and no stranger to science educators, uses a format similar to his *Tree on the Road to Turntown* to illustrate some important scientific principles. The book will appeal most to youngsters in the ten to thirteen age group, although the better readers among the eights and nines will be interested in the subject. Mike McBlossom, a lad with "a great liking for looking" thinks, at first, that rain is only for ducks. He soon finds out otherwise. Through the narrative, Mike sees seeds germinate, understands the function of gravity in moving water, illustrates the solvent properties of water, grows a vegetable garden and understands the importance of rain to city folk, country folk, plants, frogs and everyone and everything else. The book is scientifically accurate and includes several simple experiments that will interest children.

One of the strongest features of the book is Jeanne Bendick's illustrations. Mrs. Bendick's pictures are an asset to any science book for children because of their clarity, accuracy and appeal.

J. Myron Atkin
Public Schools
Great Neck, New York

The Epidemiology of Health. Iago Galdston, Editor. 197 pp. $4.00. Health Education Council. New York. 1953.

This publication of the New York Academy of Medicine is an excellent, needed presentation of the epidemiology of health as it is presently conceived by progressive medical scientists.

Originating among ancient peoples in clinical studies and in attempts to differentiate diseases, epidemiology is considered today to be synonomous with ecology and is, indeed, the science of the mutual relationship existing between man and the factors of his environment. It is no longer thought of as simply the study of diseases in people.

Health, as the distinguished authors of this book point out, denotes much more than mere absence of disease. The World Health Organization defines health

as a state of complete physical, mental, and social well-being. "We must then ask," says Dr. Owsei Temkin, in his admirable chapter entitled 'What Is Health? Looking Back and Ahead,' "whether the condition of our bodies and minds enables us to give meaning to our lives. As far as it does, we are reasonably healthy; as far as it falls short of this good, we must improve and promote our health."

This volume is, for the most part, a history of the evolution of an epidemiology of health. In chapters devoted to our contemporary world, there is thoughtful treatment of a developing epidemiology in the army and in industry and in specific areas of study such as nutrition, tuberculosis, mental health, and old age.

Emphasis throughout is on functional medicine, behavior-centered health education, and medicine for the healthy as well as for the ill.

Dr. Erich Lindemann's 'Mental Health—Fundamental to a Dynamic Epidemiology of Health,' Dr. Ralph W. Gerard's 'The Functional Approach to Medical Practice and Education—Underlining the Epidemiology of Health,' and Dr. Granville W. Larimore's 'Behavior-Centered Health Education: Its Potential Contribution to the Epidemiology of Health' are deeply significant chapters in a book rich in stimulating, thought-provoking material.

Colin McEwen
Colin McEwen Schools
Hollywood, California

Science in Daily Life. Francis D. Curtis and George Greisen Mallison. 570 pp. $3.96. Ginn and Company. Boston, Massachusetts. 1953.

Science in Daily Life is a general science text within the comprehension of the lowest grade usually taking general science but so current and satisfying as to warrant the sustained interest of the average adult. The text, authoritative and concise, has an interesting style that leads you on. All of the basic fields of science are taught but are made to flow freely and naturally from one into the other, forming a strong, dependable alloy from which the fine tools of scientific insight and problem solving are fashioned. The tests and questions are not forced but genuine and purposeful. They have the quality of making any necessary re-reading important.

Mechanically the book is a real joy. The illustrations are plentiful, of varied types, well chosen, strategically placed, and above all interesting. Color is their keynote. Markings for such things as principles of science and essential facts are clear and faithfully used. Even the footnotes don't just sit, but are right in there doing a real job of teaching all the way through.

Science in Daily Life merits being called a refreshing innovation. It is the happy result of the scientific method applied to making a science textbook.

Alton Yarian
Emerson Junior High School
Lakewood, Ohio

LIVING THINGS. Frederick L. Fitzpatrick and Thomas D. Bain. 415 pp. $3.60. Henry Holt and Company. New York. 1953.

Living Things is one of a recent crop of basic biology texts designed to meet the needs and to cope with the learning difficulties of non-academic students in secondary schools. Eight major units "present the phases of biology that the average student needs to know." Units and topics incorporated in units are introduced by brief stories. Topics are sub-divided into chapters in which, for the most part, material is organized under problems. The student is guided to the answers to these problems by a simple, logical development of principles and concepts. Most impressive is the simplicity of vocabulary and statement. Technical terms have been reduced to a minimum. New terms in each topic are clearly defined. At the conclusion of each chapter pupils may check their understanding by means of self-testing exercises. Each topic within a unit is summarized. In addition there is an overall summary of the content of the entire unit in simple concise language. These repeated summaries are valuable aids for the slow learner. Each unit incorporates activities to be pursued both in and outside of the classroom. A list of selected references is found at the end of each unit.

The printed material is arranged in two columns. For slow readers this offers certain advantages. There are many well-chosen illustrations, photographs and diagrams.

Living Things will probably make the learning of biology easier and more palatable for the type of pupil for whom it was written. However, for non-academic pupils a textbook, at best, can only supplement the wealth of first hand experiences in biology that should be afforded in the classroom, the laboratory and out of doors.

JEROME METZNER
The Bronx High School of Science
New York City

ALL ABOUT DINOSAURS. Roy Chapman Andrews. 146 pp. $1.95. Random House. New York. 1953.

This book is another in the Random House *All About . . .* series for boys and girls. It deals with the "terrible lizards" which ruled the world during a period which began 200 million years ago. Simply and interestingly written, the text is superbly illustrated by Thomas W. Voter, of the Art Department of the American Museum of Natural History in New York. Although the publisher says that the book is for children 9 to 12 years of age, surely older children and many adults will find it worthwhile and fascinating reading. Dr. Andrews has a faculty for conveying both his enthusiasms and a great deal of solid information in clear, simply-constructed sentences.

Included in the book are chapters telling of the first discovery of fossil dinosaurs and of later discoveries, including many of the author's own; descriptions of the appearance, habits, and size of the many kinds of

dinosaurs; and a discussion of the reasons for their disappearance and death. The print is large and clear on non-glare paper.

As pleasure reading or supplementary reading, this book should prove of interest and value to science students and teachers.

CLARE F. SMITH
Isaac E. Young Junior High School
New Rochelle, New York

THE BOOK OF SCIENTIFIC DISCOVERY. D. M. Turner. 285 pp. $3.95. Frederick Ungar Publishing Co. New York. 1953.

This little book attempts to itself a great task. It attempts no less than to breathe a third, yes and a fourth, dimension into the often drab material offered in many of our science courses. It does so by skillfully unfolding the great story of science from the times of Roger Bacon down to the present. For the most part, it succeeds in its task.

Interspersed throughout the text are 31 plates of such interesting items as Robert Hooke's microscope and the workshop of an alchemist. There are also over forty line drawings to illustrate the work.

We are told by the publishers that this book is a "popular introduction for young people." The tone, the language, and the personal details included indicate that it will appeal to this group.

While an index is included, there is no bibliography. Footnotes are used, but, in most cases, they are designed to expand some item above, or to give credit to the source of a direct quotation. Some reference to additional reading material on the various subjects might have been useful to the interested reader.

IRVING KAMIL
Manhattan High School of
Aviation Trades
New York City

FREE FOR THE ASKING . . . a 386-page, commercially published book, *Cellulose: The Chemical That Grows.* Written by Dr. Williams Haynes, author of *This Chemical Age; Men, Money, and Molecules;* and other works. Published by Doubleday & Company, Inc. ($4.00). Distribution to NSTA members made possible through cooperation of two sponsors. Teachers' guide included suggesting uses of the book in general science, biology, chemistry, and physics. Send your request to the National Science Teachers Association, 1201 Sixteenth St., N. W., Washington 6, D. C.

Please send me a copy of **Cellulose—The Chemical That Grows.**

Name ....

School ....

Address ....

Post Office .... Zone .... State ....

Our Advertisers